Fugro SeaSTAR®

SeaSTAR 9200-G2 Receiver
User manual

Issue 1.5 April 2010

FSP AS Ref.: B1232070OPMBRA1

April 2010

Notice to Customers

This manual has been produced to ensure the very best performance from your SeaSTAR receiver. The manual has been clearly set out with simple instructions to ensure trouble free usage of your SeaSTAR receiver.

This publication could contain technical inaccuracies or typographical errors. Changes are periodically made to the information herein; these changes will be incorporated in new editions of the manual.

Should you require further assistance please contact your local dealer or the SeaSTAR office.

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One-Year Limited Hardware Warranty

Fugro SeaSTAR AS and its operating companies world-wide (SeaSTAR), warrants this product to be free from defects in workmanship and material for a period of one year from the date of original sale by SeaSTAR or its authorised dealers, to the original purchaser or end user.

SeaSTAR reserves the right to repair and/or replace, at its option, any part or parts found to be defective, provided such defects, in their opinion, are due to faulty material or workmanship and are not caused by unauthorised or improper repair or abuse, or normal wear. Purchaser shall be responsible for shipping and insurance of the returned product for repair under this warranty. SeaSTAR will pay shipping and insurance for the product's return to purchaser provided that the product returned proves to be defective under this limited warranty.

This warranty applies only to normal usage of the product. It does not apply to units or electronic circuit boards defective due to improper installation or handling. Physical damage due to lightning or other electrical discharge and units subjected to fresh or salt-water contamination are not covered. SeaSTAR reserves the right not to warrant the product if, upon request, sufficient proof of recommended installation compliance as laid out in this manual is not provided. No other warranties are expressed or implied. No other warranties exist.

SeaSTAR assumes no responsibility for any consequential or incidental losses or damages of any nature with respect to the use of this product.

REVISION HISTORY		
Issue 1.0	May 2009	First release
Issue 1.1	May 2009	Textual changes, changes in pictures to enable document automation
Issue 1.2	June 2009	Document automation extended to include most pictures
Issue 1.3	June 2009	Small corrections, incorporated GLONASS menu structure
Issue 1.4	June 2009	Paper size changed to A4, layout fully revised.
Issue 1.41	Sep 2009	Replaced www.surveyplanner.com to www.skyfix.com
Issue 1.42	Nov. 2009	Added explanation of init string settings for NTRIP over mobile phone
Issue 1.5	Jan. 2010	Added updating firmware using WinFlash, updated menu structure to reflect the latest firmware version (FW 4.13)

Manual Reference: SeaSTAR 9200-G2 User Manual

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Introduction

About This Manual

This manual has been produced to assist the typical user with the installation and operation of the SeaSTAR 9200-G2 DGNSS Receiver.

System Features

The SeaSTAR 9200-G2 DGNSS Receiver is part of the SeaSTAR world-wide DGNSS Service. The SeaSTAR service is a full-time differential GPS and GLONASS (DGNSS) broadcast system delivering corrections from an array of GNSS reference stations located around the globe. Reference stations provide industry standard formatted corrections to Network Control Centres (NCC's) at strategic geographic locations, where the corrections are decoded, checked, and repackaged in a highly efficient format for broadcast. The data is modulated onto an RF carrier that is then up-converted for transmission to an L-band communications satellite.
The signals are received at the user's location by an antenna, demodulated by a receiver, and are made available, after selection of the desired individual reference site's data set, as corrections for use in a GNSS, differential-capable, receiver.
The SeaSTAR 9200-G2 series of receivers support the following SeaSTAR® services:
G2, this is SeaSTAR's combined GPS/GLONASS high-performance service, based on precise orbit and clock data for both GPS and GLONASS. Like XP, G2 allows for world-wide accurate positioning without having to rely on correction data of nearby land-based reference stations.
HP, this is the High Performance service where dual frequency GPS carrier phase measurements are used in an intelligent and innovative way to create wide area positioning results of unmatched accuracy and performance.
XP, this is the Extended Position service where precise orbit and clock data is used to determine the position worldwide without using any reference stations.
VBS, this is the Virtual Base Station service where single frequency GPS code phase measurements are used to create RTCM corrections data optimised for the user's current position.

Receiver Features

The SeaSTAR 9200-G2 receiver has the following features:

* 72 parallel GPS and GLONASS code/carrier tracking channels (L1 C/A-code and carrier, L2/L2C carrier only)
* 16 characters by 2 rows front panel display
* Receiver configuration using the front panel
* Submeter differential accuracy (RMS), assuming at least five satellites and a PDOP (Position Dilution of Precision) of less than four (SeaSTAR VBS)
* Decimeter differential accuracy (SeaSTAR HP/XP/G2)
* Built-in, 7.4V, 7800mAh Lithium-Ion battery
* Low power consumption
* 1, 2, 5, 10 Hz position output data (user selectable)
* A rugged, environmentally-sealed enclosure
* Everest™ multipath rejection technology
* 1 7-pin OS Lemo port for 3-wire RS232/CAN communication and power
* 1 26-pin D-sub multi-port connector, providing full RS232 communication, 3-wire RS232 communication, USB, 10/100 base TX Ethernet, 1PPS output strobe and power through suitable multiport adaptors
* Fully integrated 2.4GHz Bluetooth
* NTRIP client for SeaSTAR corrections over Ethernet (SeaSTAR IP) or GSM/GPRS/UMTS using a suitable GSM/UMTS telephone.
* GNSS antenna port

Housing

The 9200-G2 is housed in a fully sealed enclosure to provide a complete receiver solution. When connected to a suitable GNSS/L-band antenna and optionally an external power source, the 9200-G2 is a fully functioning GNSS/VBS/XP/HP/G2 receiver.

The enclosure offers protection against environmental conditions and RF interference. In addition, it provides an easy-to-use interface to the data, power and status signals of the GNSS card and a rugged, water (IP67), shock and vibration resistant housing for outdoor applications.

Accessories

The following accessories are included with the 9200-G2:

* 7-pin Lemo to RS232 and power cable
* Multiport to RS232, 10/100 base TX ethernet and power adaptor
* GPS/GNSS antenna type Z Plus or GA510
* Antenna cable (5 meters)
* Magnetic antenna mount
* 18V/3.4A external power supply
* CD containing PC utilities and product documentation

Figure 1: 9200-G2 Back Panel

Port	Description
	Antenna connector
VENT: DO NOT REMOVE.	Pressure vent
	Multiconnector (RS232 x 2, Ethernet, USB, 1PPS output, power)
	7-pin Lemo connector (RS232/CAN + power)

Table 1: 9200-G2 Back panel connections

Figure 2: GA510 antenna

Installation and Set Up

Installation Considerations

Before commencing installation of the SeaSTAR 9200-G2 on a vessel, the following should be considered:

- Determine the preferred location for each unit. Consider cable length, connector attachment space (cable bend radius), stowing excess cable, moisture, chemical corrosion, vibration and heat exposure.
- Before drilling holes, consider using existing hardware and locations where equipment was previously installed. Avoid drilling holes that may damage other equipment (e.g. structural frame members, electrical cables or fluid lines).
- High vibration and high temperature locations should be avoided whenever possible.
- In application where vibration exceeds 5Gs acceleration, shock mounts are required. (Refer to Customer support for mounting recommendations).
- Vessel primary power has voltages that may be harmful to personnel and equipment. Isolate circuit before making connection to any power terminal within the vessel.

Cable Installation

Cables must be correctly installed for optimum system operation. Therefore, the following should be noted:

- Do not route an L-Band receiver remote antenna cable with the cabling of any other radio system. This may cause interference between both systems.
- If at all possible, do not run L-Band receiver antenna cables parallel to other radio system cabling closer than 30 centimetres.
- If cables must cross, ensure that they cross at an angle of 90°. This minimises the possibility of interference.
- As far as is practicable, ensure that cables and I/O connectors are unique and fit only in their allocated location.
- Avoid routing cables along-side power generator cabling and other high electrical noise sources. This can cause interference.
- Do not kink cables or force cables into sharp bends that may damage the cables and cause system failure.
- After installation, ensure that excess cable is looped and clamped or tied safely away from any control cables, power cables, hydraulic lines or moving parts.
- When stowing over length cabling, form loops not less than 150 mm minimum cable bend radius.
- Cable routing must avoid high temperature exposure (e.g. exhaust manifold).

Features and Information

This section contains information on the features of the 9200-G2 receiver.

Strobes

On the 9200-G2, one synchronisation signal output (strobe) is given. Access to the 9200-G2 strobe signal can be obtained through the multiconnector port.

The strobe available on the 9200-G2 is the One Pulse Per Second (1 PPS) signal. The falling edge of this signal is synchronised with GPS time to within 1µs. The rising and falling edges of the pulse are 100ns, while the pulse width (pulse duration) is 5µs.

Receiver status

The 9200-G2 is equipped with a VFD (Vacuum Fluorescent Display) showing the status of the receiver. Using the display and the buttons around the display, the basic receiver settings can be configured without the need to connect a computer. The functions of the VFD display and the configuration menus are described further on in this manual.

A second way of checking the receiver status and fully configuring the receiver is through its built-in web interface. This way of configuring the receiver does require the use of a computer and a live Ethernet connection between the 9200-G2 and either the computer or a network hub/switch to which the computer is connected.

Mounting the receiver

The 9200-G2 receiver can be mounted to a flat surface using an optional mounting bracket. This mounting bracket is not provided with the receiver by default.

The receiver may also be mounted to a tripod or other upright stand using the tripod clip, which is located at the bottom of the receiver near the front panel.

Antenna Location

Antenna positioning is critical to system performance.

The following conditions must be met for optimum system performance:

- Antenna must be mounted at least 1.5 metres away from transmitting antennas of any frequency. Closer positioning may cause overloading of receiver RF circuits.
- The antenna should be mounted at the highest practical point that will give a good view of the horizon and be as near level as possible.
- The antenna must be located along the vehicle centre-line, or at a relevant reference point on the vehicle.
- The antenna should not be mounted in a location where it can easily be damaged during normal operation.

Power Supply Requirements

The 9200-G2 must be powered by a SeaSTAR approved power source of 15-28 VDC, capable of delivering at least 2A continuous output current.

Warning: Before powering the receiver, make sure the antenna cable and antenna are connected and all other cables and adapters are connected and securely locked. Connecting or disconnecting an

antenna or antenna cable when the receiver is already powered may permanently damage the receiver's antenna port or the antenna itself, voiding your warranty.

Warning: If the voltage supplied is below the minimum specification, the receiver will use the internal batteries as a power source. If the voltage of the internal batteries drops below 5V, the receiver will automatically switch off to avoid damage to the battery pack. If the voltage supplied is above the maximum specification, the receiver may be permanently damaged, voiding your warranty.

Operating considerations

The 9200-G2 has proven to be a high-quality positioning device. The accuracy that the user can obtain depends on several factors, including:

* Number of visible satellites
* Multipath
* Dilution of Precision (DOP)
* Satellite elevations
* SeaSTAR corrections

Number of visible satellites

A minimum of four satellites is required to calculate a 3-dimensional position. In general it can be said that every increase in the number of visible satellites will result in an increase in the systems' accuracy. As the GNSS satellites orbit the earth the number of visible satellites will change in time. The GPS constellation has been designed to provide a minimum of 4 visible satellites at any location at all times. The number of visible satellites can decrease due to blockage by objects such as trees and buildings.

For combined GPS+GLONASS use at least 4 GPS + 2 GLONASS satellites are required.

Multipath

It is possible for satellite signals to reflect off large nearby objects such as buildings, cars or even the ground, thereby resulting in an erroneous distance measurement. This phenomenon is known as multipath. Multipath can cause significant errors in the position determination and it is therefore important to place the receiver in an environment which is free of large reflective surfaces. It is also recommended to mount the receiver directly onto a surface, while maintaining a clear view of the sky in all directions.

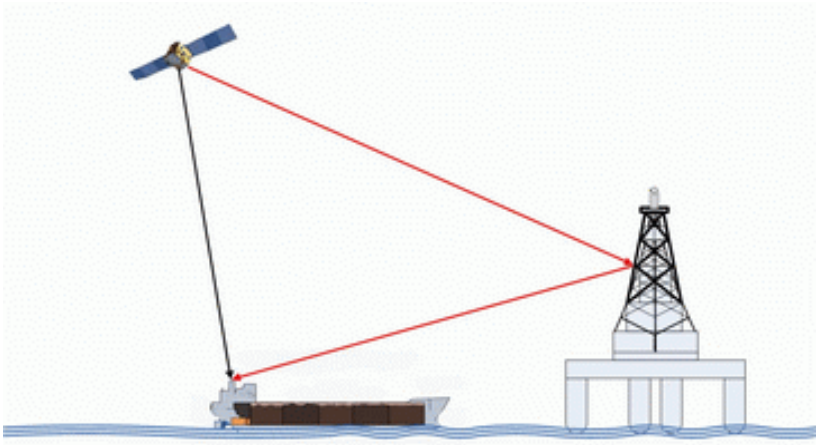


Figure 3: Multipath

Position Dilution of Precision (PDOP)

The Position Dilution of Precision (PDOP) is a measure of the satellite geometry. The closer to 1 the PDOP value, the more accurate the GNSS position will be.

Satellite elevations

The signal from a satellite that is low on the horizon will travel a greater distance through the atmosphere. This results in lower signal strength and a delayed reception, thereby causing erroneous and noisy data. By default the 9200-G2 is configured to ignore any GNSS satellites that have an elevation angle lower than 8° for HP/XP/G2 and 5° for VBS.

SeaSTAR corrections

For accurate positioning it is essential that the differential corrections are received. In order to ensure reception of the SeaSTAR satellite signal the line of sight towards the satellite must not be blocked by objects such as trees and buildings. To find out which SeaSTAR satellite(s) can be received at your geographic position, please visit the Skyfix Club website (http://www.skyfix.com/).

Interference

Although the 9200-G2 has been designed to provide optimal system performance under most circumstances, due to the nature of radio communications it is possible, that the system performance degrades as a result of local interference sources. When interference levels are too high, the 9200-G2 may even lose lock to either the SeaSTAR satellite or the GNSS satellites.

Interference sources include radio and television transmitters, radars, microwave ovens, poorly shielded spark plugs and aeronautical radio navigation systems, in short: any device producing electromagnetic energy (directly or through harmonic frequencies) in the 1525 - 1620 MHz band.

Operation

Before operating the receiver for the first time, ensure that you follow the following installation instructions.

* Mount the 9200-G2 receiver in a suitable place (see also page 7).
* Mount the SeaSTAR antenna in a suitable place (see also page 7).
* Connect the antenna cable to the antenna and the receiver. Secure the antenna cable using tie wraps.
* If desired, connect the provided data/power cable to the 7 pin Lemo port and/or connect the provided multiport adapter to the 26 pin D-sub connector and connect a suitable power supply to (one of) the power lead(s).
* Connect any or all of the available connectors as needed.
* Power on the receiver by pressing the on/off button.

Getting Started

The purpose of this section is to get you started with the 9200-G2 as quickly as possible. The guide will address receiving the satellite data carrier, and then checking the functionality and status of the L-band process.

Generally, when the receiver is supplied to you it will be configured for the mode and data link(s) you have subscribed to. In most cases getting up and running will be a case of connecting the appropriate cables and applying power to the system.

Communicating with the Receiver

Communicating with the receiver is possible using the receiver's front panel and VFD screen or using a web browser. The web browser provides complete and extensive control of the receiver, but it does require a computer/laptop and an active TCP/IP connection between the controlling computer and the receiver. The front panel is limited in its functionality, but does not require any other hardware to be connected. Because the 9200-G2's display only provides 2 lines of 16 characters, the receiver uses a number of menus and submenus to access the receiver's information and configuration screens.

Starting the Receiver

The receiver's software resides in read-only memory. As such, the unit "self-boots" when switched on and undergoes a complete self-test. When the receiver is first switched on, it will show the text 'Booting' on the screen, followed by a screen showing receiver type (9200) and current receiver firmware version. A few seconds later, the main screen will show.

The Receiver Home screen

Upon booting successfully, the receiver will show the main screen. The top row of the main screen will show the positioning mode and the number of GPS and GLONASS satellites used for positioning. The second row of the display will show the horizontal 2D, 95% position accuracy and the name and signal strength of the selected SeaSTAR beam. Figure 4 shows a possible main screen.

Figure 4: 9200-G2 main screen

The 9200-G2 menu structure

The 9200-G2 menu structure can be divided into two types of screens: information screens that will only show information and configuration screens that allow the user to change receiver settings. Some of the configuration screens may change into information screens based on the settings of other configuration screens.

A full overview of the menu structure of the 9200-G2 is shown in Figure 5. From the main screen, the information screens can be accessed by pressing either the ▲ or ▼ buttons.
To enter the configuration screens, press the Enter button first. Use the ▲ and ▼ buttons to select the configuration submenu to view and use the Enter button to scroll through the various configuration submenu screens.

Editing a value can be done by pressing the ▶ button to select edit mode, then use the ▲ and ▼ buttons to change the value and the Enter button to store the changes.

When a screen shows more than one editable value, use the ▲ and ▼ buttons to select the correct value before pressing the ▶ button.

Within an editable field, the ◀ and ▶ buttons may be used to select a different character to be changed.

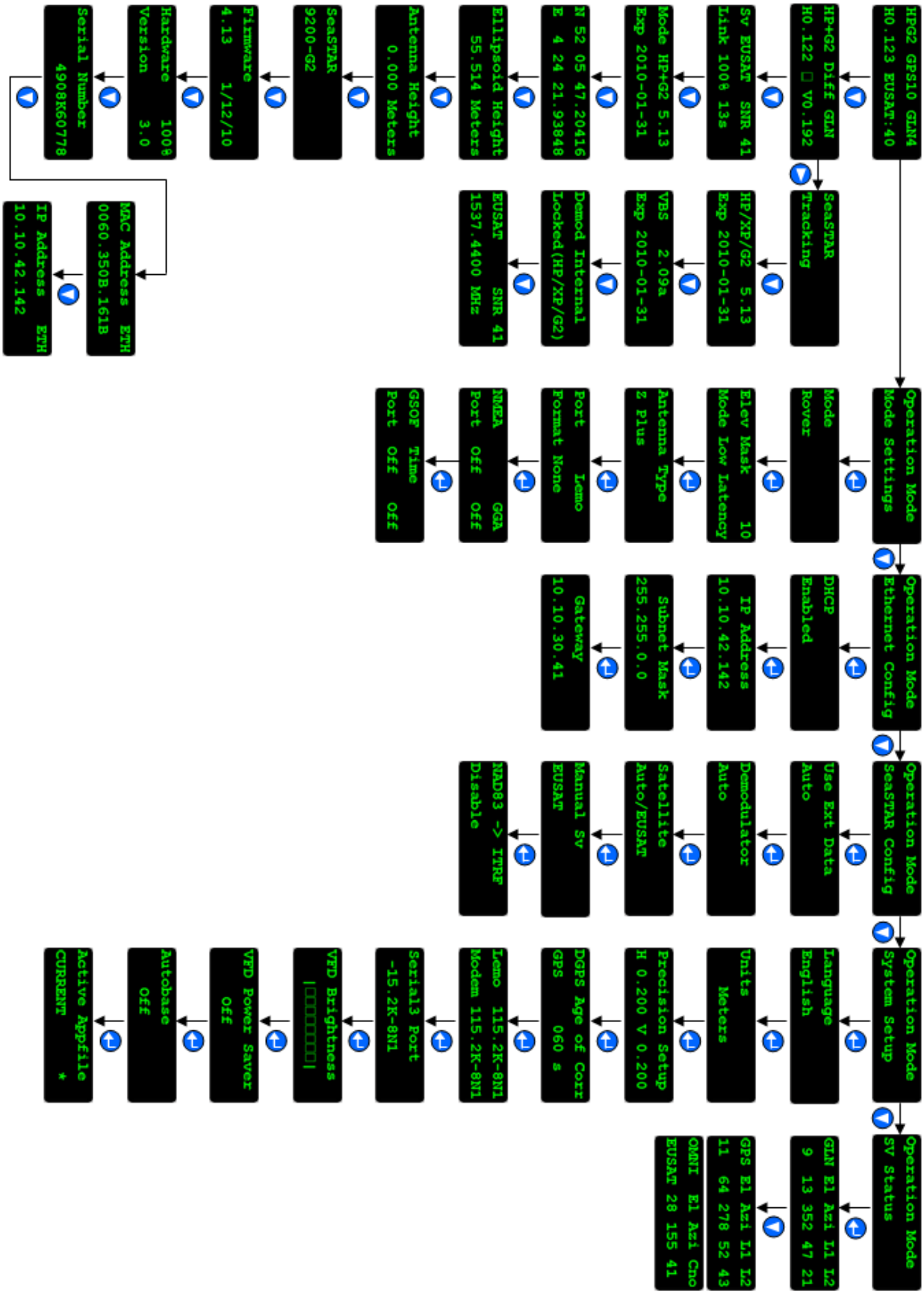


Figure 5 9200-G2 menu structure

The main screen will show the current positioning mode of the receiver, the number of GPS and GLONASS satellites in use for a position calculation, the horizontal (2D, 95%) position accuracy and the name and signal strength of the SeaSTAR DGPS correction beam the receiver is tuned to.

9200-G2 information screens

By pressing the ▲ and ▼ buttons from the main screen, the receiver will scroll through the information menus (see Figure 5, leftmost column). The following information will be given (in order of appearance by pressing the ▼ button repeatedly):

* **Instantaneous horizontal and vertical accuracies**. The arrow symbols between the two values (◂ ▸) indicate whether or not the accuracy values exceed the preset convergence thresholds. A blinking arrow symbol indicates the larger of the values exceeding the convergence threshold. During convergence, up/down arrow symbols will show whether the horizontal and vertical accuracies are increasing or decreasing. By pressing the ▶ button once while in this screen, followed by either the ▲ or ▼ buttons, extra information about the **L-band tracking status**, **SeaSTAR operation mode**, **activation end dates** of all SeaSTAR operation modes, **SeaSTAR DGPS engine** versions and **name, signal strength and frequency** of the selected SeaSTAR L-band satellite beam are shown.
* **L-band information**: the name of the selected SeaSTAR L-band satellite beam, the signal to noise ratio of the L-band signal and the age of data of the correction signal. Typical SeaSTAR age of data values fall within the 5 to 30 second range, so make sure not to set the age of data limit too low.
* **Current SeaSTAR operation mode** (VBS, HP, XP or G2), **SeaSTAR correction engine version** and the **SeaSTAR activation end date** for the current operation mode. It is possible for the 9200-G2 receiver to have different activation end dates for the different SeaSTAR operation modes (VBS, HP/XP/G2).
* **Current position** in either WGS-84 (ITRF2005) or NAD-83 (VBS United States only) coordinates.
* **Height of the antenna** above the ellipsoid.
* **Antenna height offset**.
* **Receiver model**.
* **Receiver firmware version** and compilation date.
* **Receiver hardware version**
* **Receiver serial number**. This number will consist of 4 digits, the letter ‘K’ and another 5 digits. The SeaSTAR serial number needed to activate the receiver is 14xxxxx, where xxxxx are the five digits following the letter ‘K’. Taking the menu in Figure 5 as an example, the receiver serial number is 4908K60778 and the corresponding SeaSTAR serial number is 1460778.
* **Ethernet MAC address** (unique hardware address of the built-in ethernet card) of the receiver.
* **Ethernet IP address** of the receiver. When the receiver is not connected to an active Ethernet network and it has not been assigned a static IP address, the IP address will be ‘0.0.0.0’. When the receiver is connected to an active Ethernet network and it is not assigned an IP address by the DHCP server while DHCP mode is enabled, the receiver will assign itself an IP address in the range 169.254.xxx.yyy.

9200-G2 configuration screens

By pressing the Enter button from the main screen or any of the information screens, the receiver configuration screens will be accessed. The receiver features five configuration categories which can be selected by pressing the ▲ or ▼ buttons when in the ‘Operation Mode’ screen. The five configuration categories are Mode Settings, Ethernet Config, SeaSTAR Config, System Setup and SV Status. Although they are part of the configuration menus, the SV Status screens only provide information about the GPS and GLONASS (when GLONASS option is enabled) SVs and the SeaSTAR L-band signal.

Mode Settings

Within the Mode Settings menu, it is possible to scroll through the mode setting screens by pressing the Enter button repeatedly. When the last of the mode setting screens has been displayed, pressing the Enter button once more will show the main screen again.
The mode settings menu contains the following items:

* **Mode**. This screen shows the operational mode of the receiver. This screen will always show 'Rover', since the 9200-G2 has not been enabled to be operated as an RTK base station.
* **Elevation mask and filter mode**. The elevation mask controls the minimum elevation angle above which a GNSS satellite is used in the position calculations. The elevation mask angle can be set between 0 (all visible satellites will be used) and 90 (no GNSS satellites will be used) degrees. Note: HP/XP/G2 will always use an 8 degrees mask angle regardless of the receiver's Elevation mask setting. The mode can be either Low Latency or RTK Sync.
* **Antenna type**. In this screen, the antenna connected to the receiver can be selected from a list of different antenna types. For 'Rover' use, filling in this field is optional, since the receiver will probably not use the extra information obtained by providing the correct antenna type.
* **Port configuration**. This screen can be used to select whether one of the output ports (either the 7 pin Lemo or one of the RS232 ports on the multiconnector) should be used to output binary VBS RTCM data. Format None indicates the selected port does not output VBS RTCM data.
* **NMEA configuration**. Using this screen, the outputs and output frequencies of the three physical serial ports (Lemo, Modem and Serial 3) can be set. A complete list and description of the output messages can be found in Appendix B. Possible output frequencies are once every 10 minutes, once every 5 minutes, once every 60 seconds, once every 30 seconds, once every 15 seconds, once every 10 seconds, once every 5 seconds, once every 2 seconds, 1Hz, 2Hz, 5Hz and 10Hz.

  Note: The total amount of output messages over all possible outputs combined cannot exceed 20.

* **GSOF configuration**. GSOF is a binary output protocol that may be used to output information to any GSOF compatible device. A list of GSOF output messages can be found in Appendix C. Possible output frequencies are equal to the NMEA output frequencies mentioned above.

Ethernet Config

Within the Ethernet Config menu, it is possible to scroll through the Ethernet setting screens by pressing the Enter button repeatedly. When the last of the Ethernet setting screens has been displayed, pressing the Enter button once more will show the main screen again.
The Ethernet config menu contains the following items:

* **DHCP**. Using this screen, the receivers' DHCP (Dynamic Host Configuration Protocol) client can be enabled or disabled. When DHCP client is enabled, the receiver will obtain an IP address from the Ethernet network automatically, provided the network is running a DHCP server. When the receiver is DHCP enabled, the other screens in the Ethernet Config menu will be information screens instead of configuration screens
* **IP Address**. Using this screen, it is possible to assign a fixed IP address to the receiver. When the receiver is in DHCP mode, this screen will either show the IP address assigned to the receiver by the DHCP server or a self-assigned IP address in the range 169.254.xxx.yyy in case a DHCP server is not available on the Ethernet network.
* **Subnet Mask**. Using this screen, the TCP/IP subnet mask can be set. When the receiver is in DHCP mode, the subnet mask belonging to the Ethernet network will be shown.
* **Gateway**. Using this screen, the IP address of the gateway (link to the rest of the network / the internet) can be entered. When the receiver is in DHCP mode, the IP address of the gateway as provided by the DHCP server will be shown.

SeaSTAR Config

Within the SeaSTAR Config menu, it is possible to scroll through the SeaSTAR setting screens by pressing the Enter button repeatedly. When the last of the SeaSTAR setting screens has been displayed, pressing the Enter button once more will show the main screen again.
The SeaSTAR config menu contains the following items:

* **Use Ext Data**. Using this screen, it is possible to set the types of external SeaSTAR correction data the receiver will accept over one of the input ports (either physical, Bluetooth or TCP/IP). Options are Auto (receiver will use any external SeaSTAR DGNSS input signal), XP (receiver will only use HP, XP or G2 external SeaSTAR DGNSS input signals), VBS (receiver will only use VBS external SeaSTAR DGPS input signals) or Off (receiver will not accept any external SeaSTAR DGNSS signals)
* **Demodulator**. Using this screen, it is possible to select which types of SeaSTAR correction data will be generated by the internal SeaSTAR demodulator. Options are Auto (SeaSTAR demodulator will generate DGNSS corrections based on signals received and SeaSTAR subscription), HP/XP/G2 or a combination hereof (SeaSTAR demodulator will only generate XP, HP or G2 DGNSS corrections), VBS (SeaSTAR demodulator will only generate VBS DGPS corrections) or Off (internal SeaSTAR demodulator disabled).
* **Satellite**. Using this screen, the receiver can be put in either 'Automatic selection' or 'Manual selection' mode. Regardless of the satellite selection mode, the SeaSTAR satellite beam currently used will be displayed.
* **Manual SV**. Using this screen, the satellite beam for the SeaSTAR correction signals can be selected. This screen will not be displayed when 'Auto' satellite selection mode is selected.
* **NAD 83 -> ITRF**. Using this screen, the receiver can be configured to either use or don't use the NAD 83 to ITRF datum transformation. This datum transformation is only necessary when running the receiver in VBS mode in the United States.

System Setup

Within the System Setup menu, it is possible to scroll through the System setup screens by pressing the Enter button repeatedly. When the last of the System setup screens has been displayed, pressing the Enter button once more will show the main screen again.

The System setup menu contains the following items:

* **Language**. Using this screen, the language of the receiver menus can be selected. Languages provided are English, Suomi (Finnish), Français (French), Deutsch (German), Italiano (Italian), Norsk (Norwegian), Polski (Polish), Español (Spanish), Svenska (Swedish) and Nederlands (Dutch).
* **Units**. Using this screen the measurement/display units can be selected. Options are either meters (metric system) or US Feet.
* **Precision Setup**. Using this screen, the convergence thresholds for SeaSTAR HP/XP/G2 convergence can be set. Default SeaSTAR convergence threshold values are 30cm/1 ft, both horizontally and vertically.
* **DGPS Age of Corr**. Using this screen, the maximum allowed DGPS and DGLONASS ages of data can be set. The validity of SeaSTAR correction messages is 300 seconds for HP/XP/G2 and 600 seconds for VBS, with a typical age of data value between 5 and 25 seconds. If the DGPS/DGLONASS age of data threshold is set too low, the receiver may start dropping in and out of differential mode, resulting in an unuseable output signal.
* **Lemo/Modem settings**. Using this screen, the baudrate and parity of the Lemo port and the Modem (Serial 2) port can be set. Baudrates can be set between 2k4 and 115k2, parity can be N(one), O(dd) or E(ven).
* **Serial3 Port settings**. Using this screen, the baudrate and parity of serial port 3 can be set.
* **VFD Brightness**. Using this screen, the brightness of the receiver's display can be controlled.
* **VFD Powr Saver**. Using this screen, the screen saver can be enabled or disabled. When the screen saver is enabled, the receiver screen will not be lit and will therefore not show any information. When the screen saver is in Auto mode, when the receiver is not running off an external power supply, the screen will switch off after a certain amount of time only to be switched on again after one of the front panel buttons is pressed. When the screen saver is disabled, the screen will always be lit and always show information. Enabling the screensaver or putting it in

Auto mode will help reduce the power consumption of the receiver, thus increasing battery life time when the receiver is running off the internal batteries.

* **Autobase**. The autobase operation mode is only useful when the receiver is used in RTK base station mode, which the 9200-G2 receiver is not capable of.
* **Active Appfile**. In this screen the active appfile can be chosen. An app file (application file) holds a number of receiver settings that will be loaded into the receiver at or after receiver startup. When no app file is defined, a new app file 'Current' will be created and used.

SV Status

Within the SV Status menu, it is possible to scroll through the SV Status screens by pressing the Enter button repeatedly. When the last of the SV Status screens has been displayed, pressing the Enter button once more will show the main screen again.
The SV Status menu only contains one item:

* **GPS information screen**. This screen will show PRN number, elevation, azimuth and signal to noise ratio on both GPS frequencies for all currently available GPS satellites. When the GLONASS option is enabled, the screen will also show the same information about the currently available GLONASS satellites. The last subscreen will show the elevation, azimuth and Cno (carrier to noise ratio) of the currently selected SeaSTAR satellite. To cycle through the list of available satellites, press the ▽ button repeatedly.

Configuring the receiver over Ethernet

Although the 9200-G2 can be configured using the front panel, the easier and more powerful way of configuring the receiver is through its built-in web interface. Of course, an active Ethernet connection (either a direct link cross-cable or through a home or company Ethernet network) is required for this configuration method, as is the provided break-out cable which has to be connected to the multi-connector port of the 9200-G2.
Using the receiver's front panel, press the △ button once to show the receiver's IP address. On a laptop or desktop computer connected to the receiver (either directly or through a network), open a new web browser window and type the IP address of the receiver in the address bar. First, you will be asked for a username and password to login to the receiver. The default username and password combination is 'admin' and 'password'. After a short time, the receiver's main screen will show inside the browser (see Figure 6).
The default menu language is English, but that can be changed by clicking the flag symbol of the desired language. Please note that some of the languages may require you to install additional fonts on your computer. Available languages include English, (simplified) Chinese, Finnish, French, German, Italian, Japanese, Dutch, Norwegian, Polish, Russian, Spanish and Swedish.

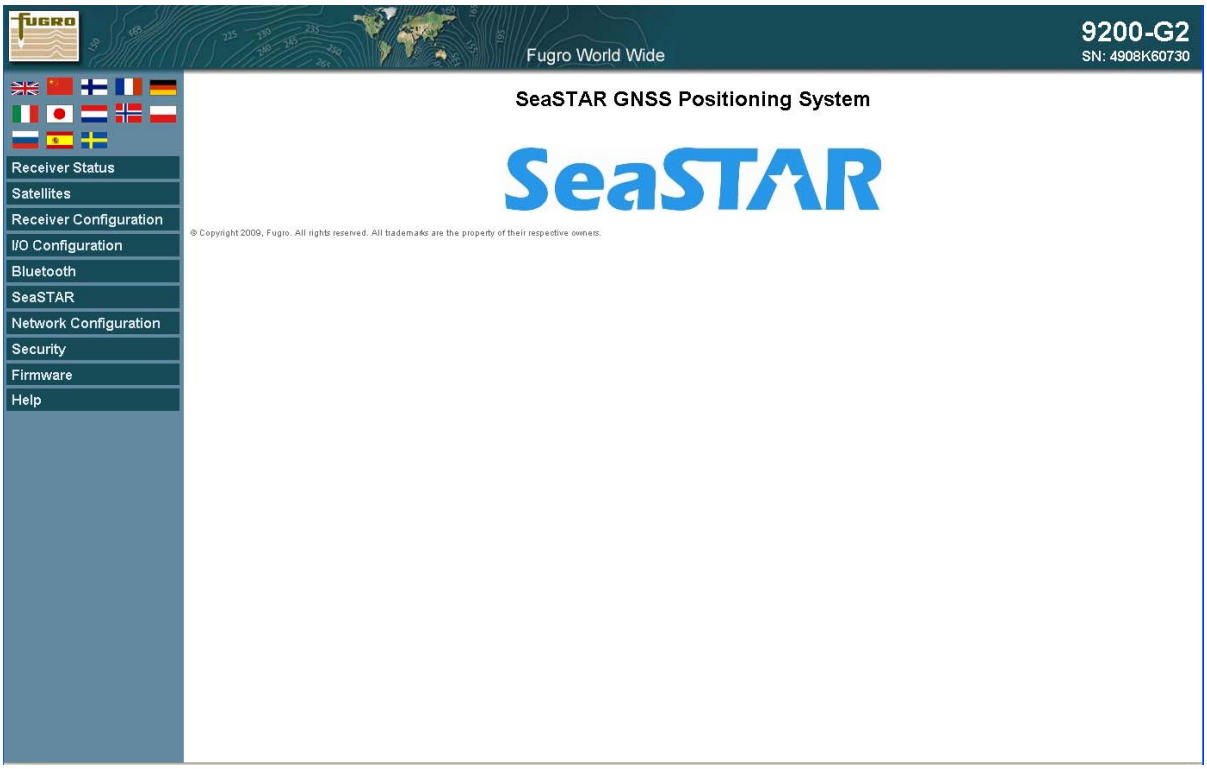


Figure 6 9200-G2 menu structure

The menu items shown on the left-hand side of the screen will provide access to both status and configuration screens.

Receiver Status menu

By clicking the 'Receiver Status' in the left-hand side menu, the receiver status menu will open (see Figure 7). The following submenu items can be found:

- Home — Will show the receiver's web interface home screen
- Identity — Will show the receiver's serial number, MAC addresses, IP address and hardware and firmware versions
- Receiver Options — Provides an overview table of the receiver's currently enabled options and provides the possibility to enable or disable options by entering an option code
- Activity — Will show a complete overview of the current satellite status, all input and output signals, the receiver temperature and the external/internal power status
- Position — Will show detailed information about the receiver's current position and position status
- Position (Graph) — Will show a graphical overview of either height, easting, northing or PDOP/ number of satellites versus time or easting versus northing, based on receiver measurements since the receiver was last switched on or reset or receiver measurements over the last 24 hours, whichever time period is shorter.
- Vector — Will show detailed information about the receiver's current position and heading, when two 9200-G2s are connected in 'heading output' mode (note: extra hardware and cabling which is not provided with the 9200-G2 will be needed to operate the receiver in heading mode).
- Google Earth — Provides a reference link to include the 9200-G2s position and receiver information in Google Earth.

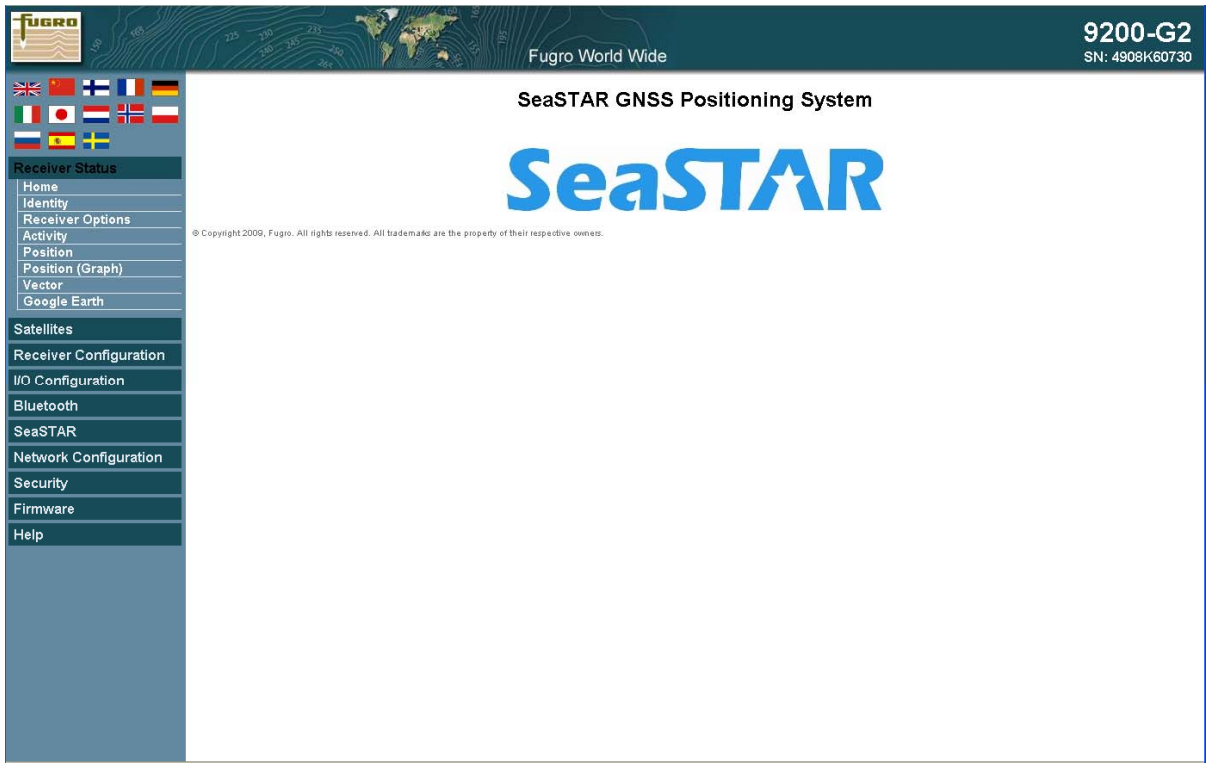


Figure 7 9200-G2 receiver status menu (Home screen)

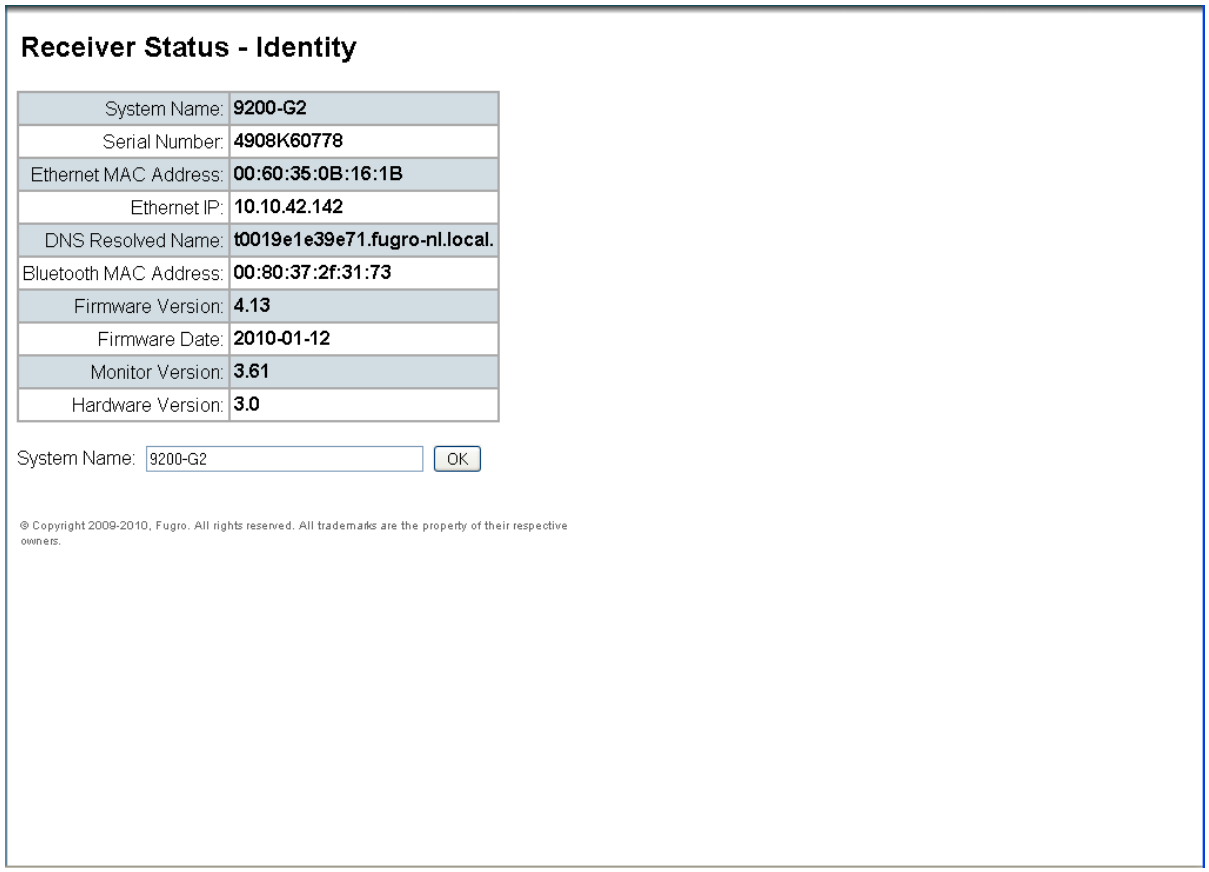
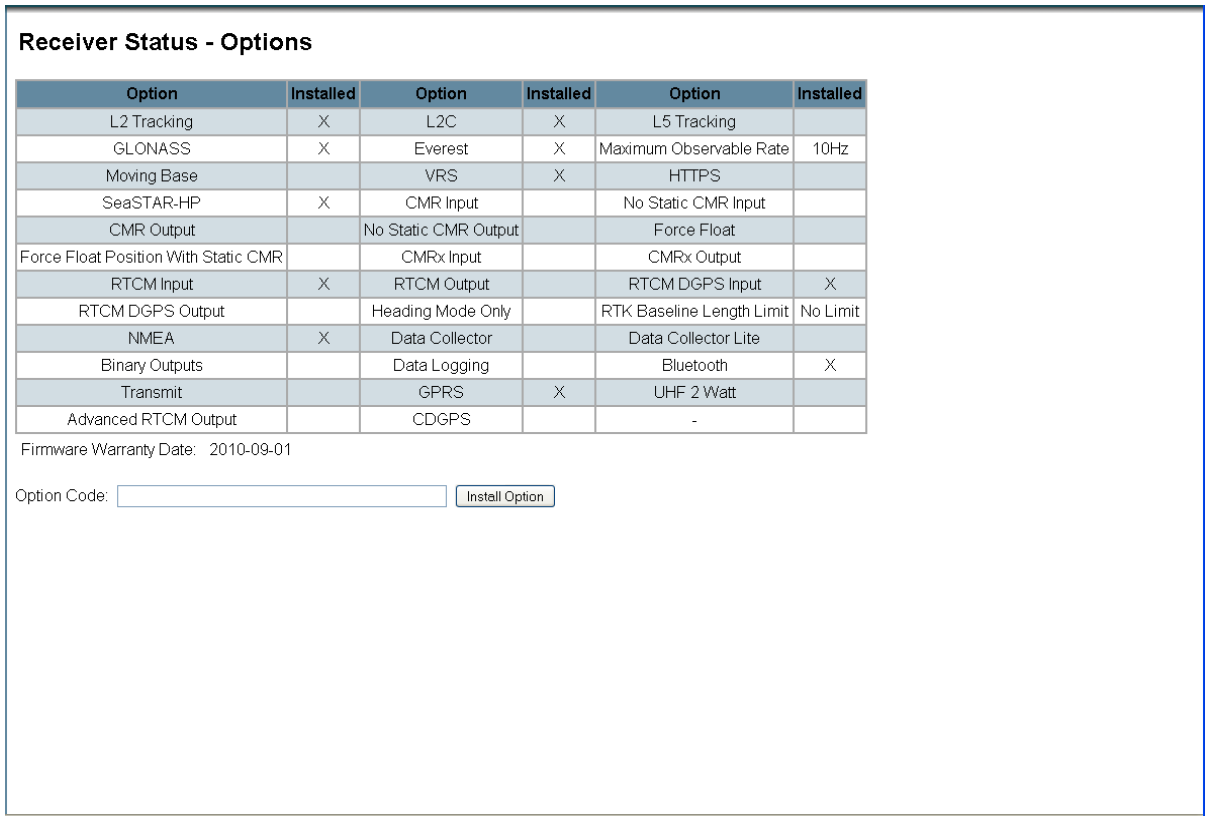


Figure 8 9200-G2 Identity menu



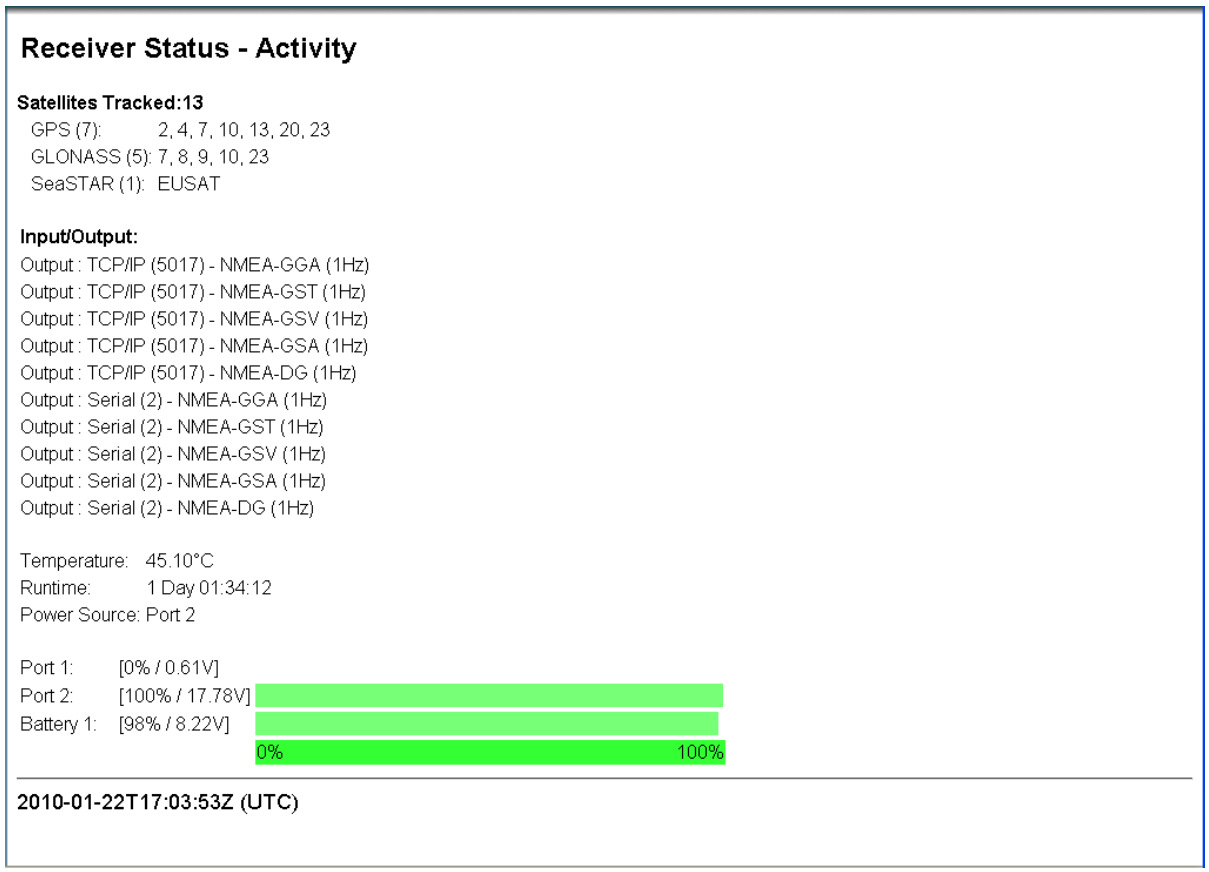
Receiver Status - Options

Option	Installed	Option	Installed	Option	Installed
L2 Tracking	X	L2C	X	L5 Tracking	
GLONASS	X	Everest	X	Maximum Observable Rate	10Hz
Moving Base		VRS	X	HTTPS	
SeaSTAR-HP	X	CMR Input		No Static CMR Input	
CMR Output		No Static CMR Output		Force Float	
Force Float Position With Static CMR		CMRx Input		CMRx Output	
RTCM Input	X	RTCM Output		RTCM DGPS Input	X
RTCM DGPS Output		Heading Mode Only		RTK Baseline Length Limit	No Limit
NMEA	X	Data Collector		Data Collector Lite	
Binary Outputs		Data Logging		Bluetooth	X
Transmit		GPRS	X	UHF 2 Watt	
Advanced RTCM Output		CDGPS		-	

Firmware Warranty Date: 2010-09-01

Option Code: Install Option

Figure 9 9200-G2 receiver options



Receiver Status - Activity

Satellites Tracked:13
GPS (7): 2, 4, 7, 10, 13, 20, 23
GLONASS (5): 7, 8, 9, 10, 23
SeaSTAR (1): EUSAT

Input/Output:
Output : TCP/IP (5017) - NMEA-GGA (1Hz)
Output : TCP/IP (5017) - NMEA-GST (1Hz)
Output : TCP/IP (5017) - NMEA-GSV (1Hz)
Output : TCP/IP (5017) - NMEA-GSA (1Hz)
Output : TCP/IP (5017) - NMEA-DG (1Hz)
Output : Serial (2) - NMEA-GGA (1Hz)
Output : Serial (2) - NMEA-GST (1Hz)
Output : Serial (2) - NMEA-GSV (1Hz)
Output : Serial (2) - NMEA-GSA (1Hz)
Output : Serial (2) - NMEA-DG (1Hz)

Temperature: 45.10°C
Runtime: 1 Day 01:34:12
Power Source: Port 2

Port 1: [0% / 0.61V]
Port 2: [100% / 17.78V]
Battery 1: [98% / 8.22V]
0% 100%

2010-01-22T17:03:53Z (UTC)

Figure 10 9200-G2 Receiver activity overview

Receiver Status - Position

Position:
Lat : 52° 5' 46.51124" N
Lon : 4° 24' 21.55636" E
Hgt : 59.157 [m]
Type : SeaSTAR HP+G2
Datum : ITRF05

Position Solution Detail:
Position Dimension : 3D
Position Type : SeaSTAR HP+G2
Motion Info : Roving
Augmentation : GPS+GLN
RTK Solution : N/A
RTK Init : N/A
RTK Mode : N/A
RTK Network Mode : N/A
Age of Corrections : 8.0 [Sec.]
Height Mode : Normal

Satellites Used:11
GPS(7): 2, 4, 7, 10, 13, 20, 23
GLONASS(4): 7, 8, 10, 23

Satellites Tracked:13
GPS (7): 2, 4, 7, 10, 13, 20, 23
GLONASS (5): 7, 8, 9, 10, 23
SeaSTAR (1): EUSAT

Receiver Clock:
GPS Week: 1567
GPS Seconds: 493549
Offset: -0.13839 [msec]
Drift: -0.52024 [ppm]

Multi-System Clock Offsets:
Master Clock System: GPS
GLONASS Offset: 43.7 [ns]
GLONASS Drift: -0.060 [ns/s]

Velocity:
East : 0.01 [m/s]
North : 0.00 [m/s]
Up : -0.02 [m/s]

1-Sigma Estimates:
East : 0.027 [m]
North : 0.036 [m]
Up : 0.048 [m]
Semi Major Axis : 0.036 [m]
Semi Minor Axis : 0.027 [m]
Orientation : 4.573°

Dilutions of Precision:
PDOP : 1.8
HDOP : 1.1
VDOP : 1.4

2010-01-22T17:05:34Z (UTC)

Figure 11 9200-G2 Position status

Position (Graph)

Height | 10-Second Positions | New Window

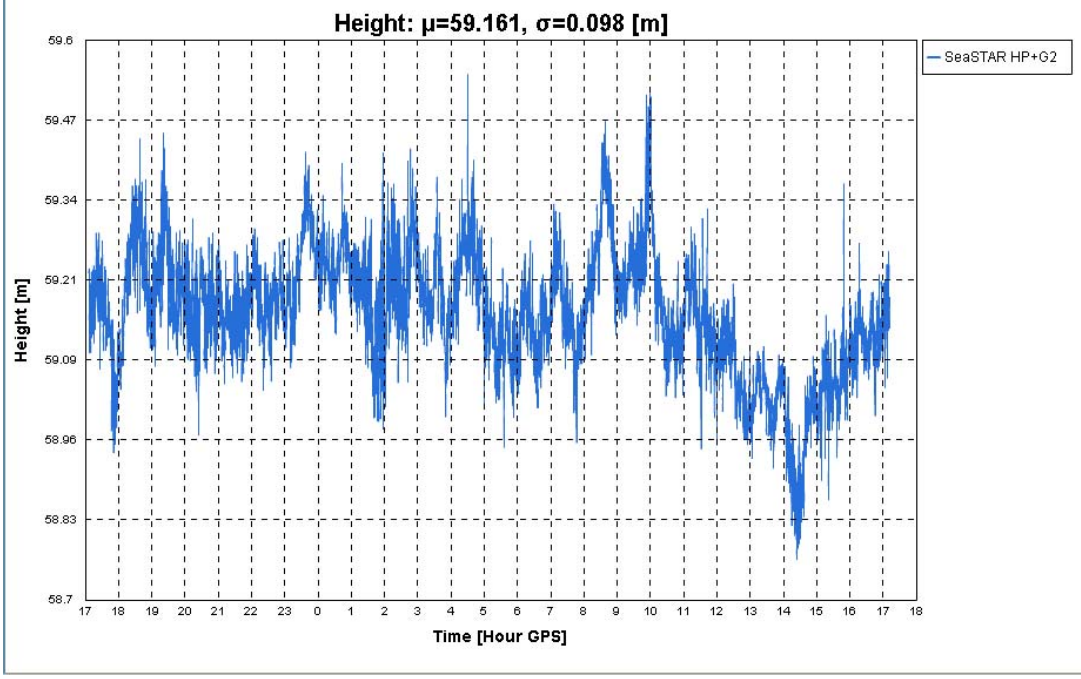


Figure 12 9200-G2 Position graph

Fugro SeaSTAR®

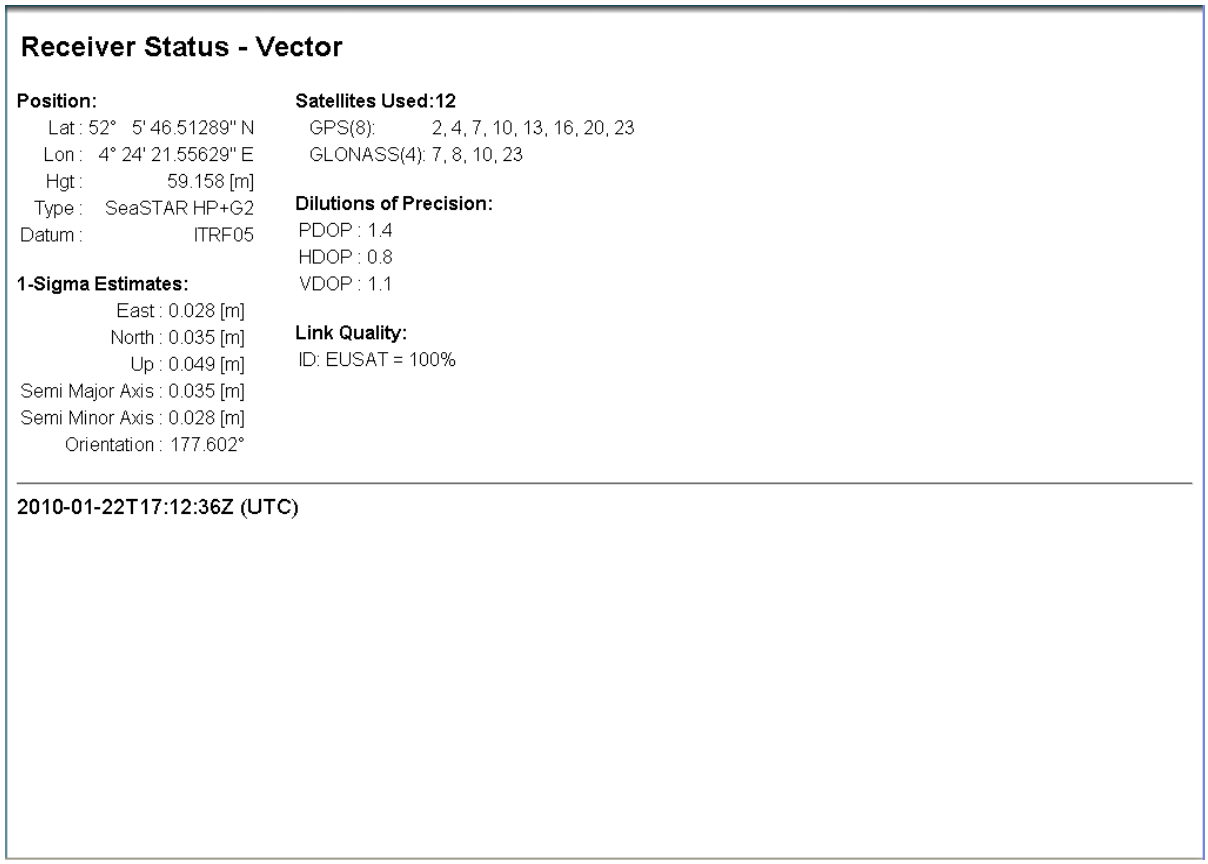


Figure 13 9200-G2 Vector status

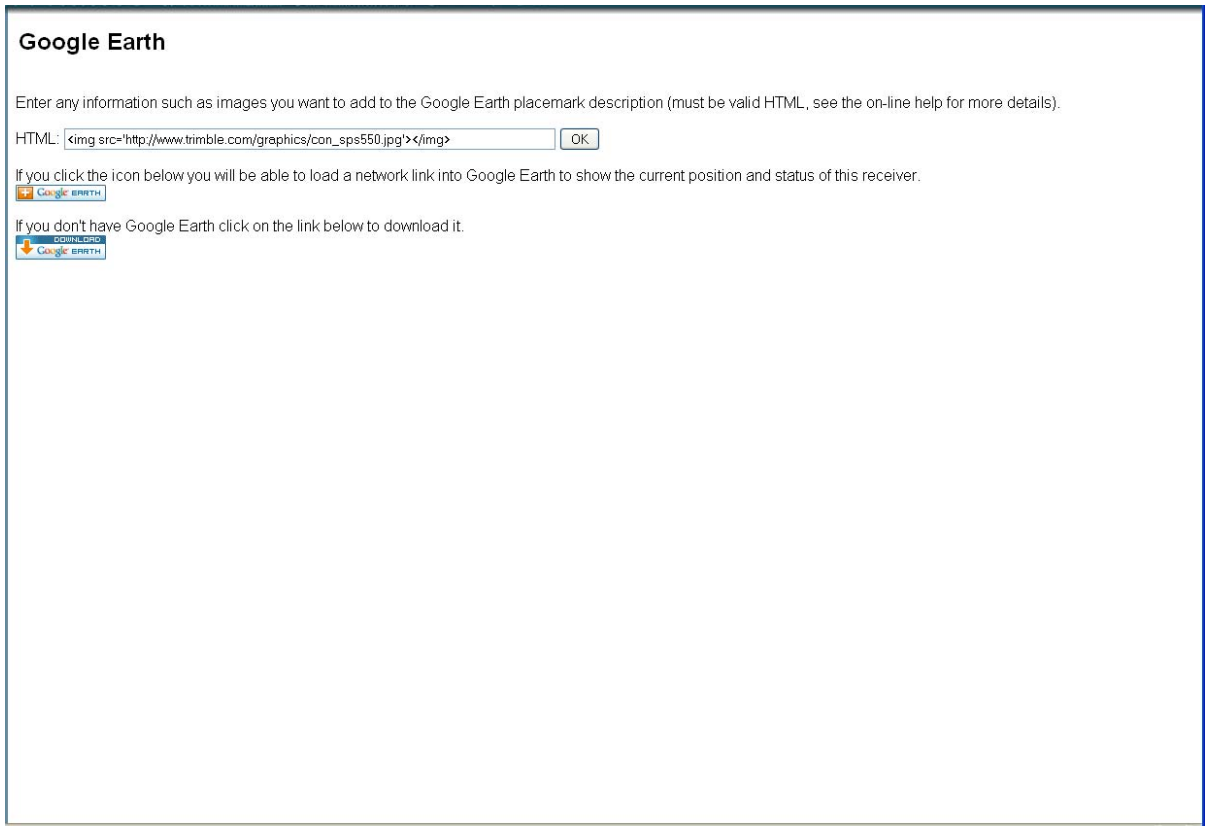


Figure 14 9200-G2 Google Earth

Satellites menu

By clicking ‘Satellites’ in the left-hand side menu, the satellite overview and configuration menu will be opened (see Figure 15). This window will show the PRN numbers of the GNSS satellites currently tracked, the name of the SeaSTAR satellite currently tracked and information about the complete GNSS constellation, including satellite health status. The following submenus can be found:

* Tracking (Table) — Will present information about all the satellites currently being tracked by the receiver.
* Tracking (Graph) — Will present the same information as the table, only in a graphical form.
* Tracking (Skyplot) — Will show a skyplot overview of the locations of all the satellites currently visible/tracked.
* GPS enable/disable — Gives the user the possibility to exclude certain GPS satellites from being used by the 9200-G2 receiver or to force the receiver to use certain GPS satellites reported as being unhealthy.
* GLN enable/disable — (When GLONASS option is installed) Gives the user the possibility to exclude certain GLONASS satellites from being used by the 9200-G2 receiver or to force the receiver to use certain GLONASSS satellites reported as being unhealthy.
* SBAS enable/disable — Gives the user the possibility to enable or disable the use of SBAS (WAAS, EGNOS, GAGAN, MSAS) DGNSS correction signals or to exclude certain SBAS satellites from being used by the 9200-G2 receiver.
* Satellite almanacs — Provides a link to download the GPS almanac from the 9200-G2 receiver to your computer
* Predicted elevation — Graphically shows the 24-hour predicted satellite elevation relative to the receivers’ position for the selected GNSS satellite. The vertical red line indicates the current time.
* Predicted constellation — Graphically shows the amount of GNSS satellites available to the receiver for the next 24 hours on the receivers’ current location. The vertical red line indicates the current time.
* Current constellation — Graphically shows the global positions of all the GNSS satellites for the current date and time.
* Ground track — Graphically shows the ground track for the next 24 hours, the current position of the selected GNSS satellite and its visibility given the current receiver location.

Please note that certain menu items may require the installation of extra software or browser plugins on your computer.

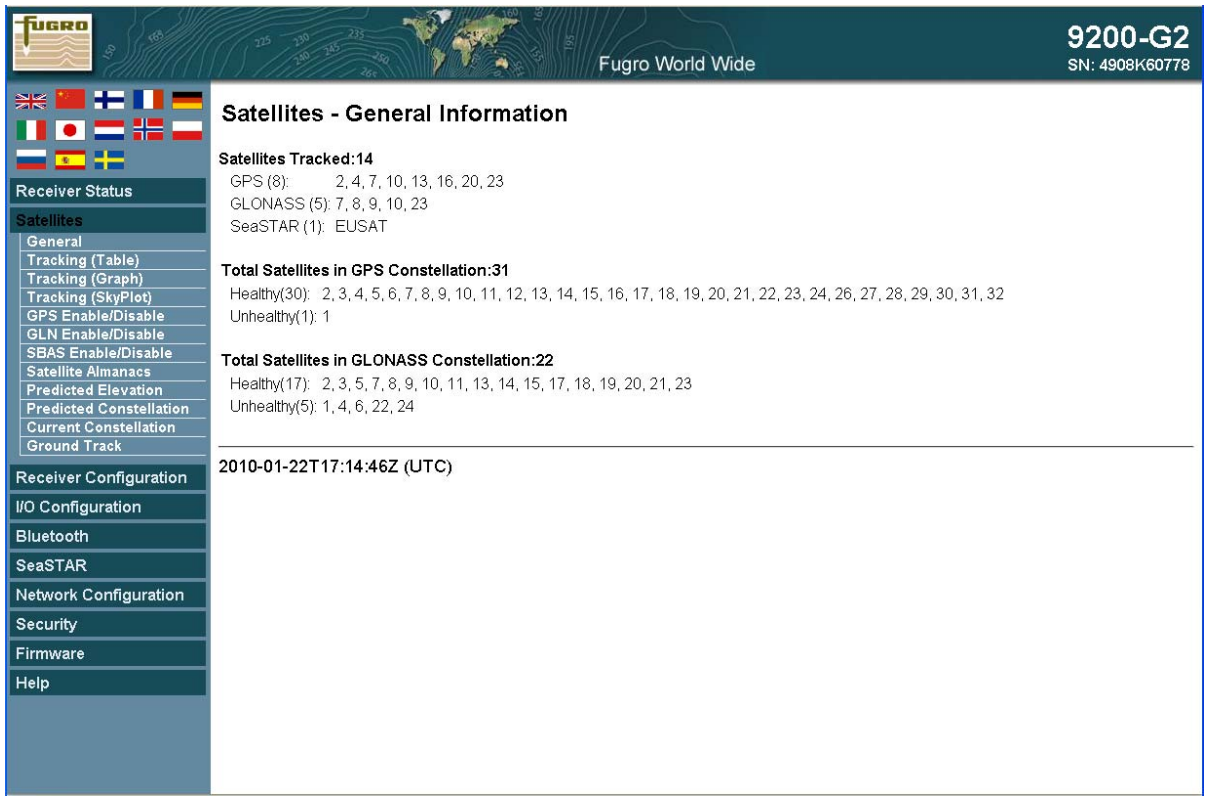


Figure 15 9200-G2 Satellites menu – general information

Satellites - Tracking Information

SV	Type	Elev. [Deg]	Azim. [Deg]	L1-C/No [dBHz]	L1	L2-C/No [dBHz]	L2	IODE	URA [m]	Type
2	GPS	40.23	297.09	48.8	CA	38.8	E	32	2	IIR
4	GPS	56.40	230.53	51.2	CA	42.0	E	95	2	IIA
7	GPS	35.98	163.76	49.2	CA	46.6	CM+CL	8	2	IIR-M
7	GLONASS	74.84	54.30	54.6/52.5	CA/P	43.0	P	81	10	M
8	GLONASS	40.70	301.00	50.7/48.0	CA/P	45.7	P	81	4	M
9	GLONASS	53.54	122.33	55.7/51.6	CA/P	51.0	P	81	7	M
10	GPS	21.68	289.98	45.8	CA	28.7	E	63	2	IIA
10	GLONASS	17.39	171.48	45.8/43.9	CA/P	37.2	P	81	5	M
13	GPS	84.00	75.41	51.0	CA	43.7	E	37	2	IIR
16	GPS	11.33	54.65	36.8	CA	19.0	E	64	2	IIR
20	GPS	21.49	113.02	43.0	CA	25.8	E	76	2	IIR
23	GPS	49.04	64.80	49.5	CA	39.7	E	48	2	IIR
23	GLONASS	27.60	281.69	48.0/45.0	CA/P	36.3	P	81	7	M
EUSAT	SeaSTAR	28.49	154.52	45.0	-	-	-	-	-	-

2010-01-22T17:15:42Z (UTC)

Figure 16 9200-G2 Satellite tracking information (table)

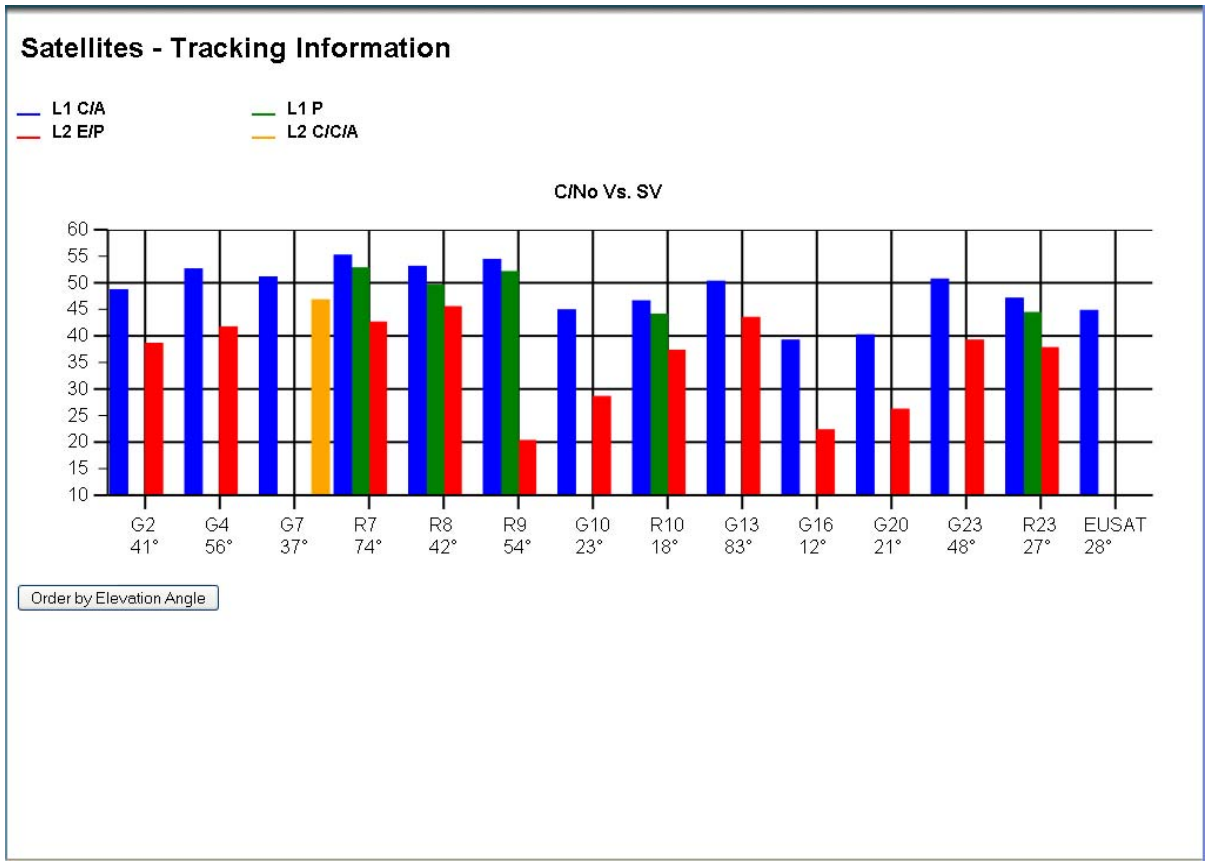


Figure 17 9200-G2 Satellite tracking information (graph)

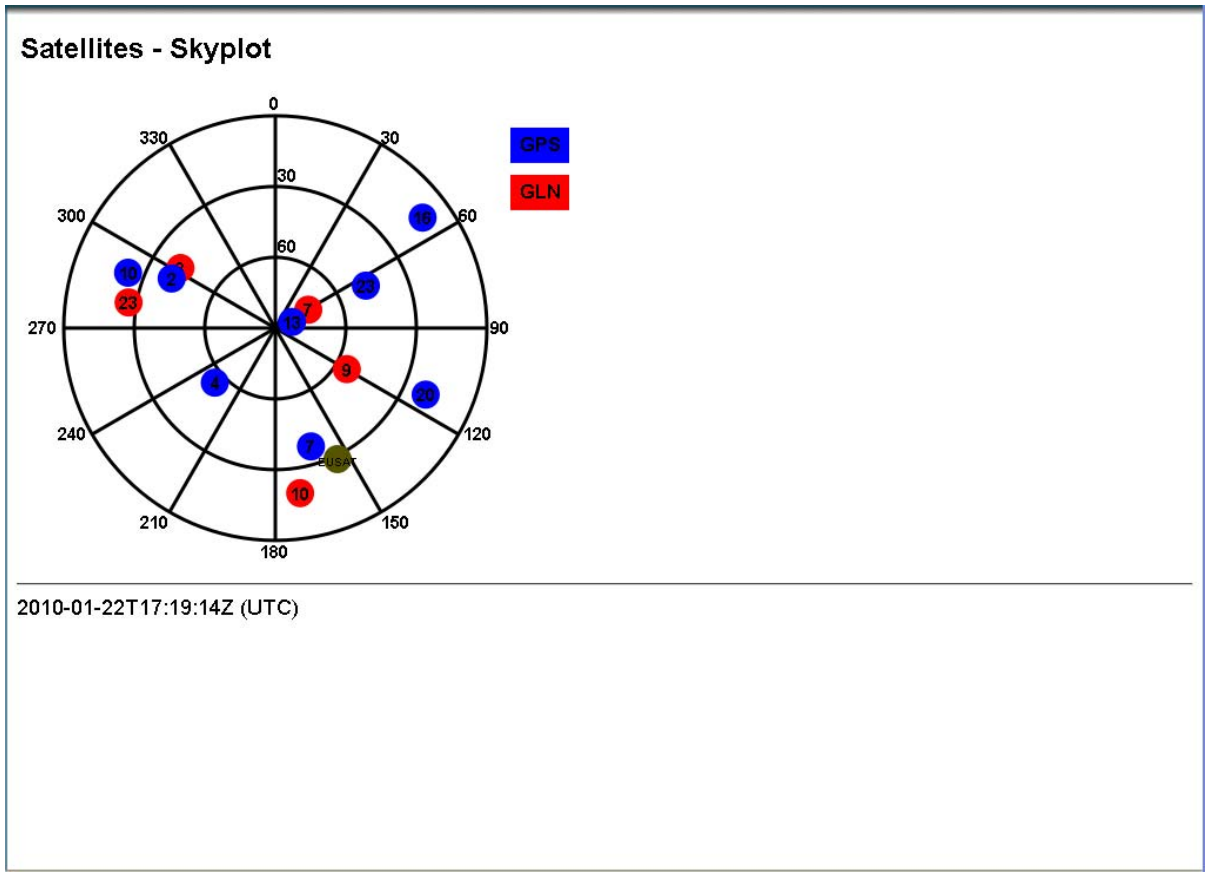


Figure 18 9200-G2 Satellite tracking information (skyplot)

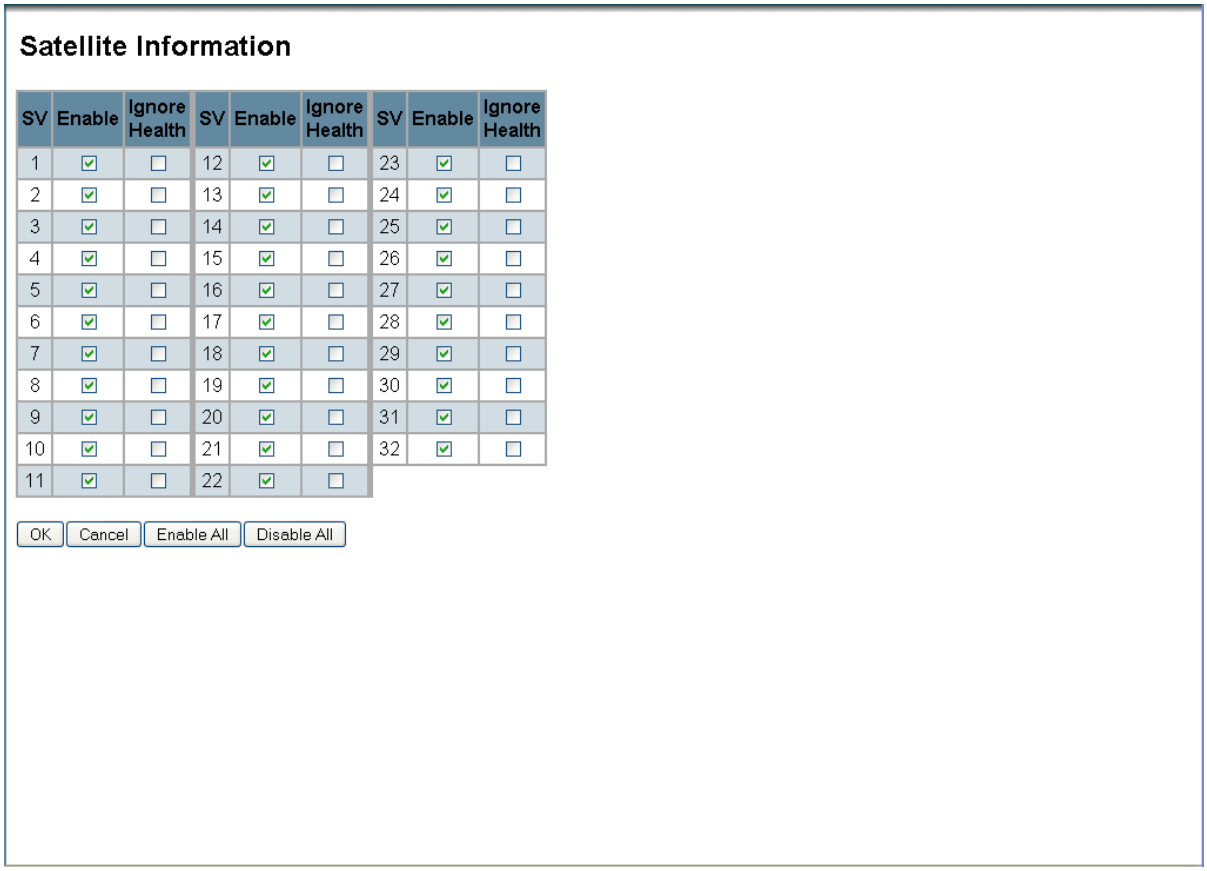


Figure 19 9200-G2 GPS enable/disable

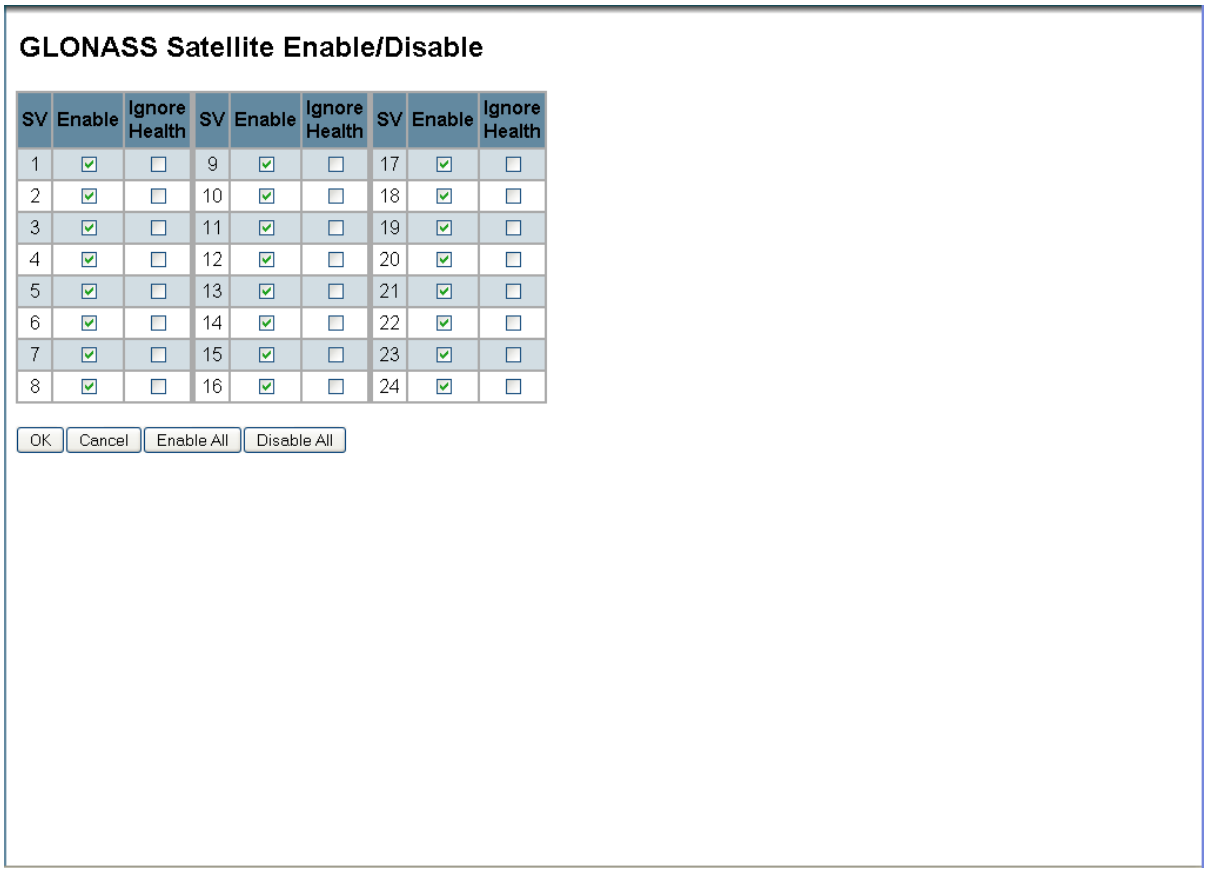


Figure 20 9200-G2 GLONASS enable/disable

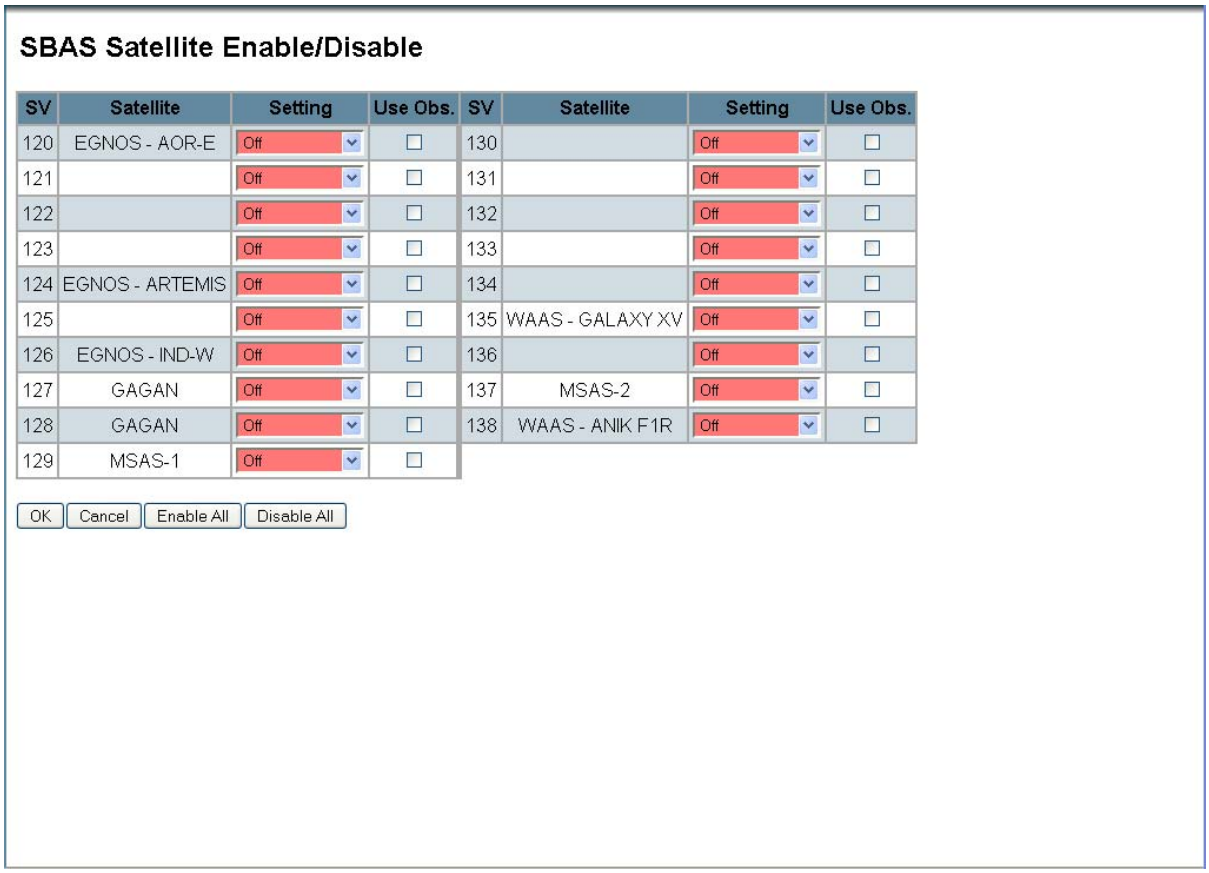


Figure 21 9200-G2 SBAS enable/disable

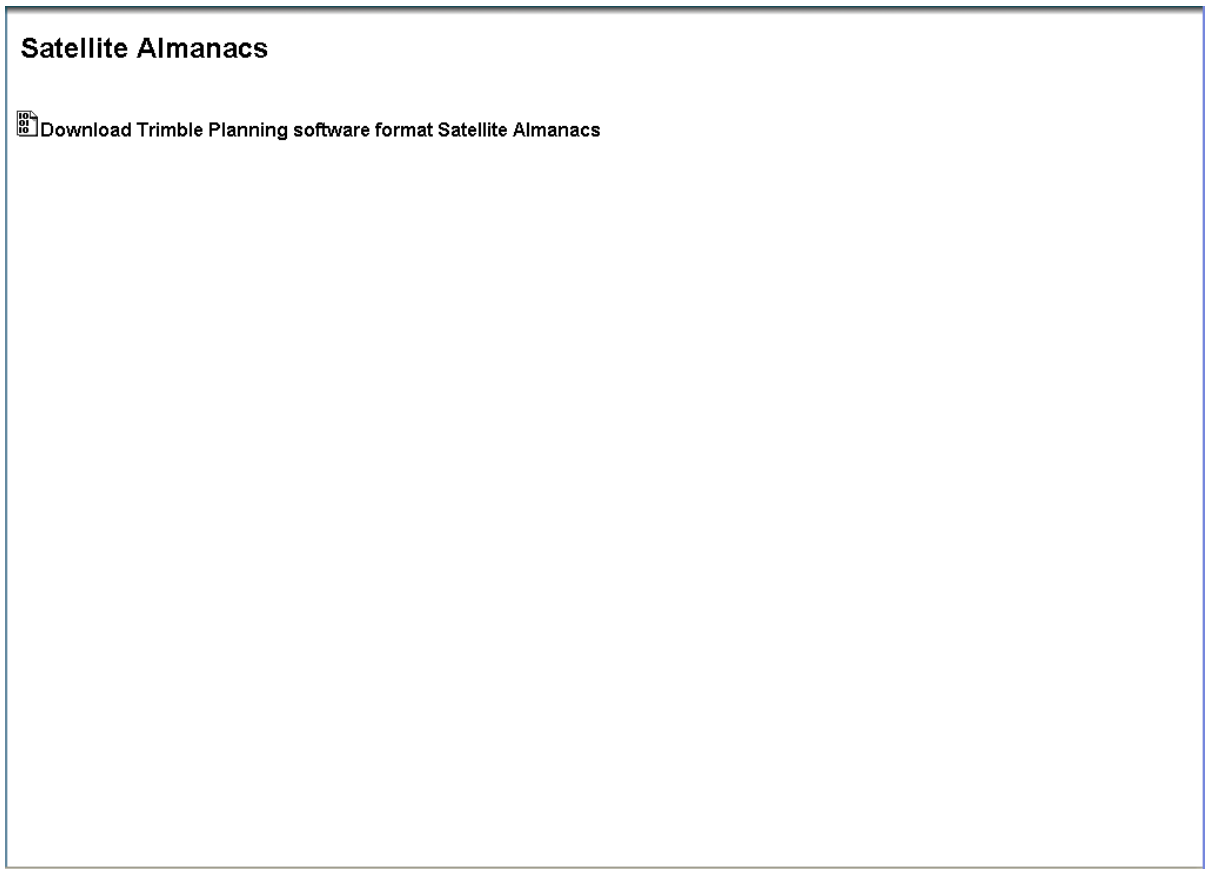


Figure 22 9200-G2 Satellite Almanacs screen

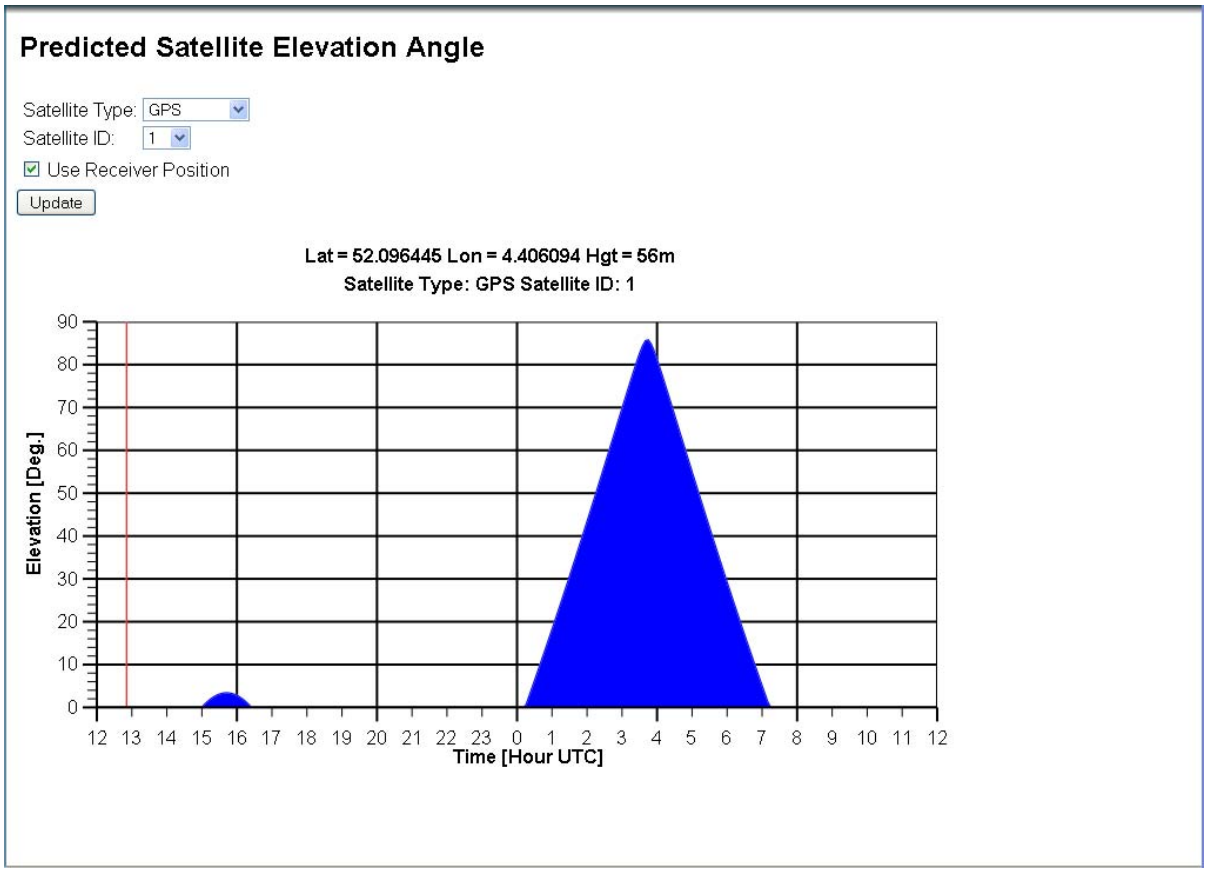


Figure 23 9200-G2 GNSS Predicted elevation angle

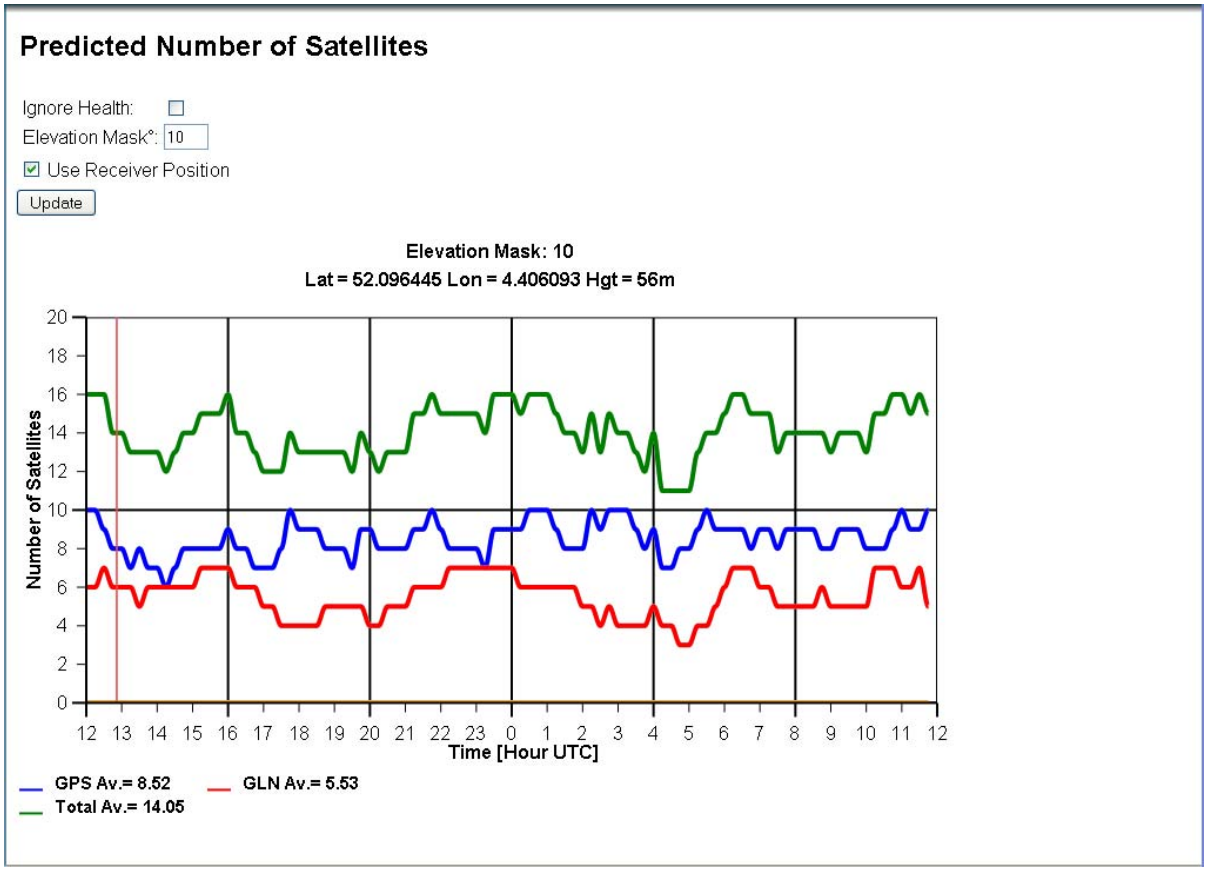


Figure 24 9200-G2 Predicted constellation (visible GNSS satellites)

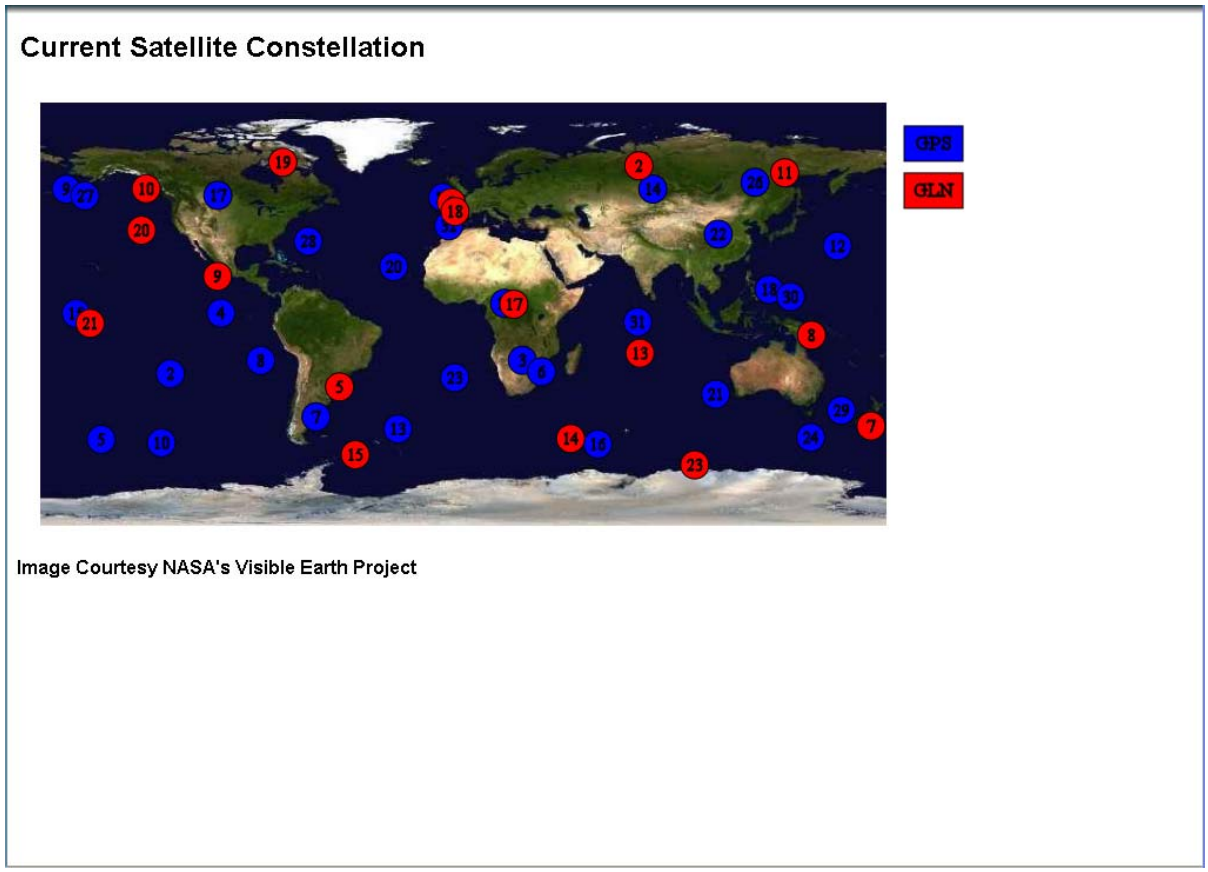


Figure 25 9200-G2 Plot of current GNSS constellation

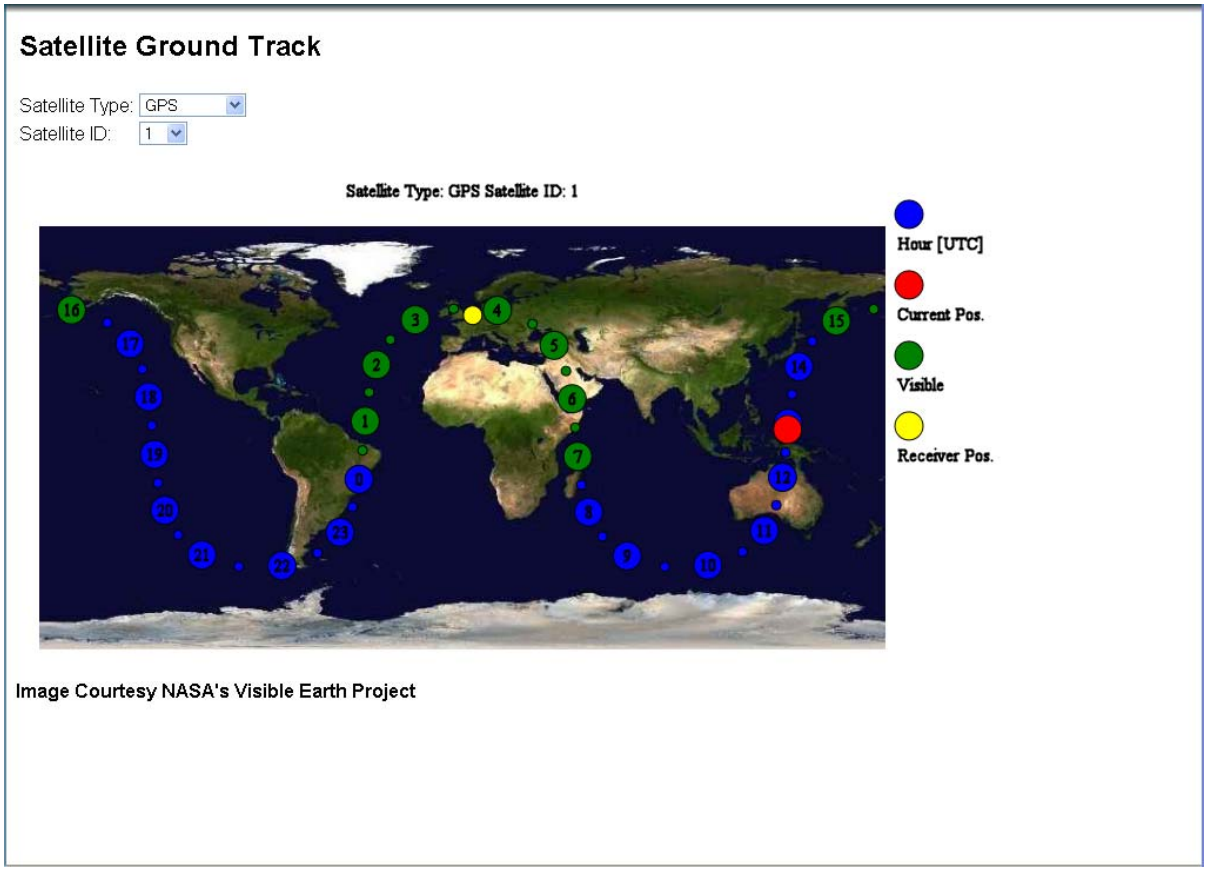


Figure 26 9200-G2 GNSS satellite ground track

Receiver Configuration

By clicking the 'Receiver Configuration' in the left-hand side menu, the receiver status menu will open (see Figure 27). The summary screen will show the current receiver configuration settings. The following submenus can be found:

* Antenna — In the antenna configuration screen, the type of antenna currently connected to the 9200-G2 receiver can be selected and some extra information about the antenna can be stored.
* Tracking — In the tracking configuration screen, the type(s) of signal(s) the receiver should track on the different GNSS frequencies can be selected.
* Position — In the position screen, the receiver mask angles, SeaSTAR HP/XP convergence limits and DGNSS age of data limit can be adjusted.
* General — The general configuration screen controls the receiver operational settings and display behaviour.
* Application Files — An application file contains all the receiver (default) settings. Using an application file, the receiver can be fully and quickly configured.
* Reset factory — Using the reset screen, certain receiver parameters can be reset to their default values.
* Default Language — The default web interface language can be selected from the 13 available languages listed in this screen.

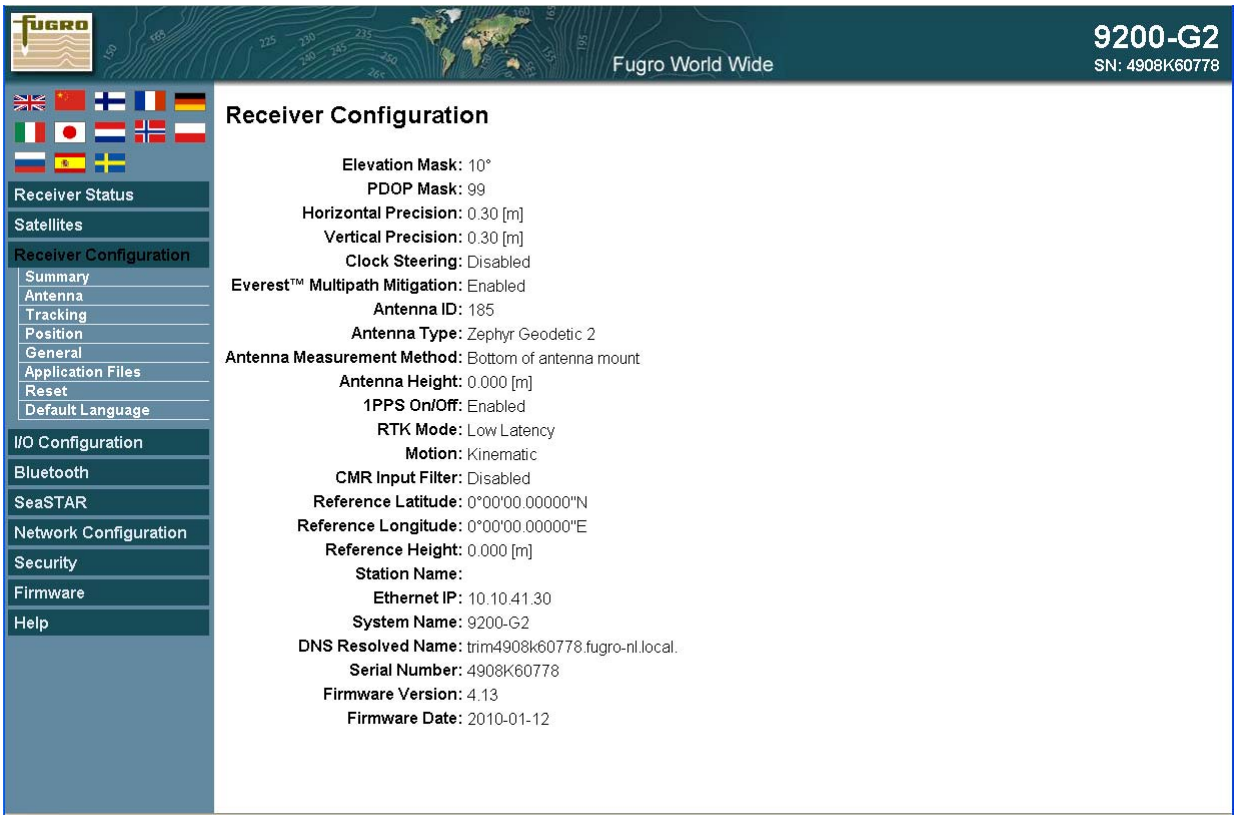


Figure 27 9200-G2 receiver configuration screen

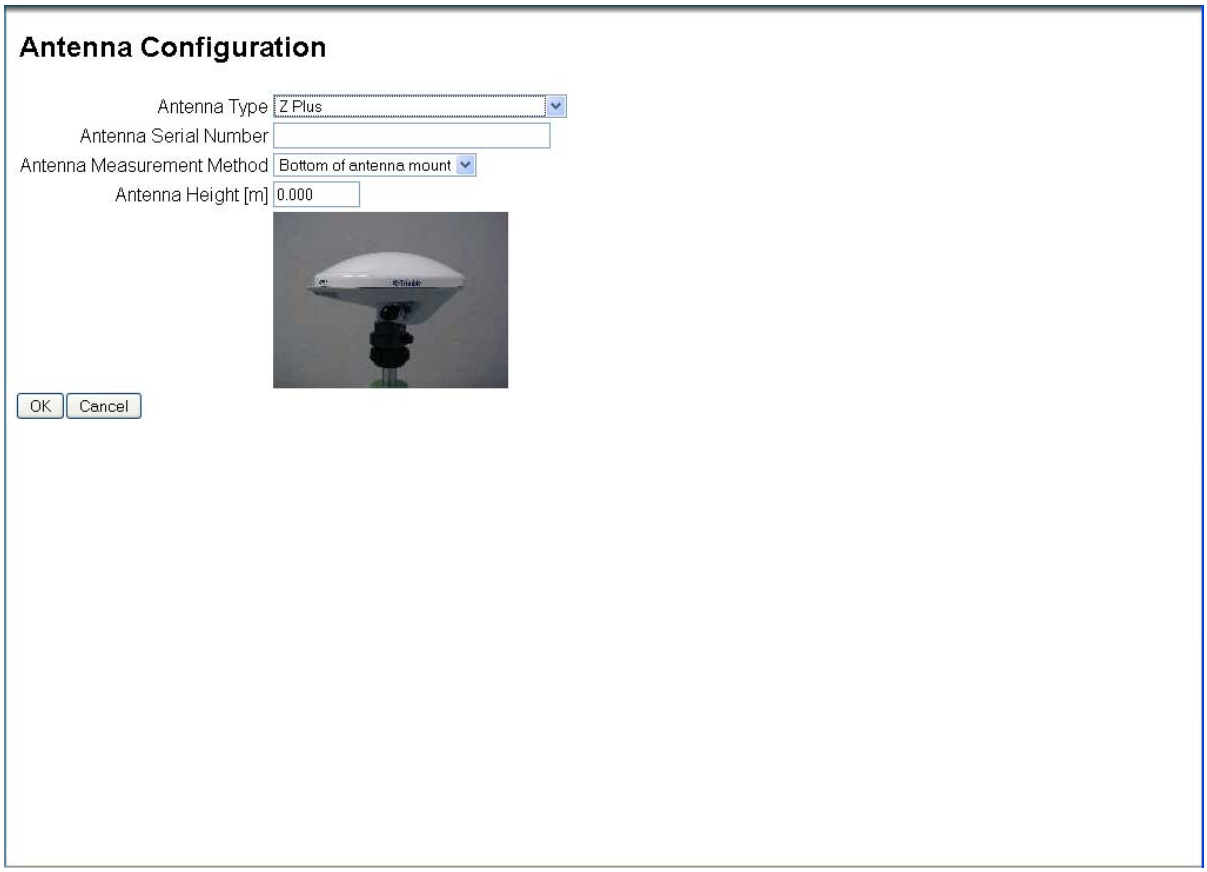


Figure 28 9200-G2 Antenna configuration screen

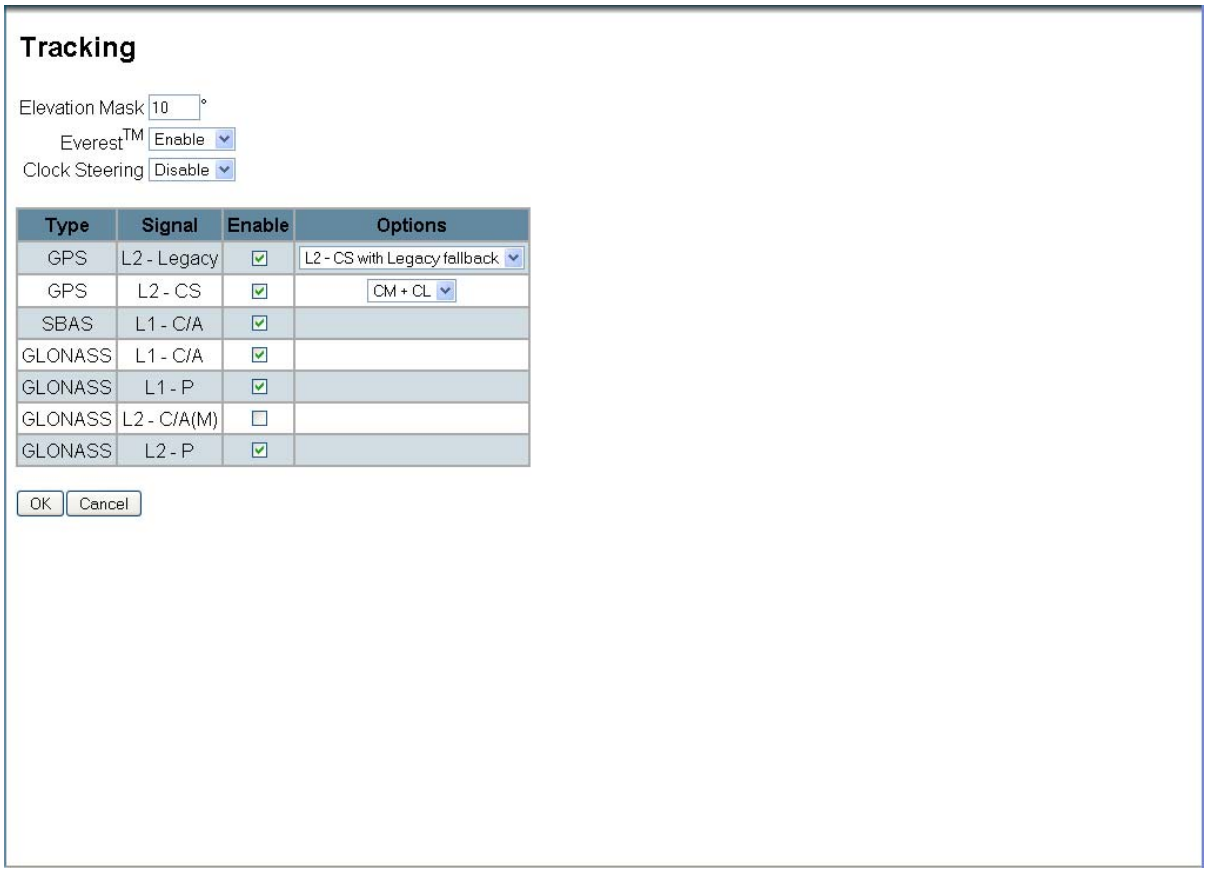


Figure 29 9200-G2 Tracking configuration screen

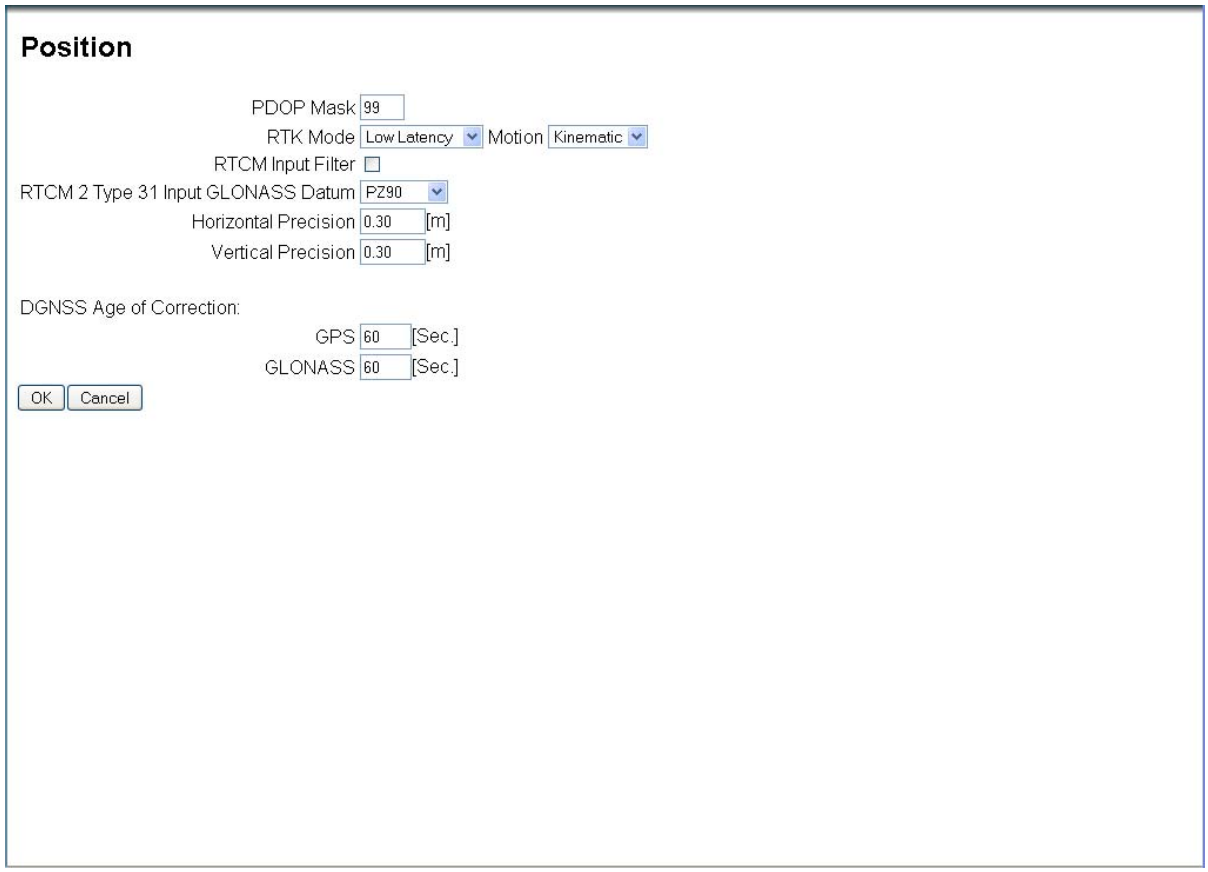


Figure 30 9200-G2 Position configuration screen

Figure 31 9200-G2 General configuration screen

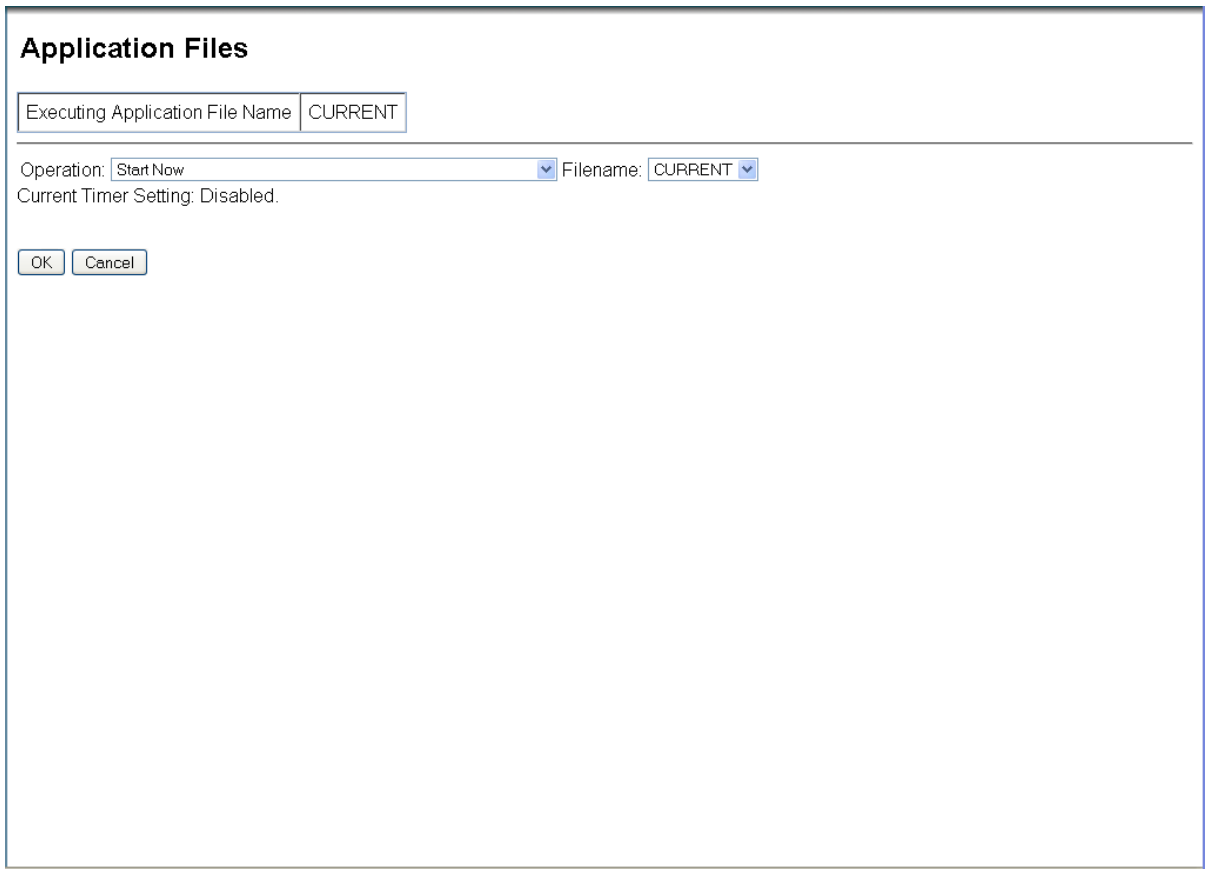


Figure 32 9200-G2 Application Files configuration screen

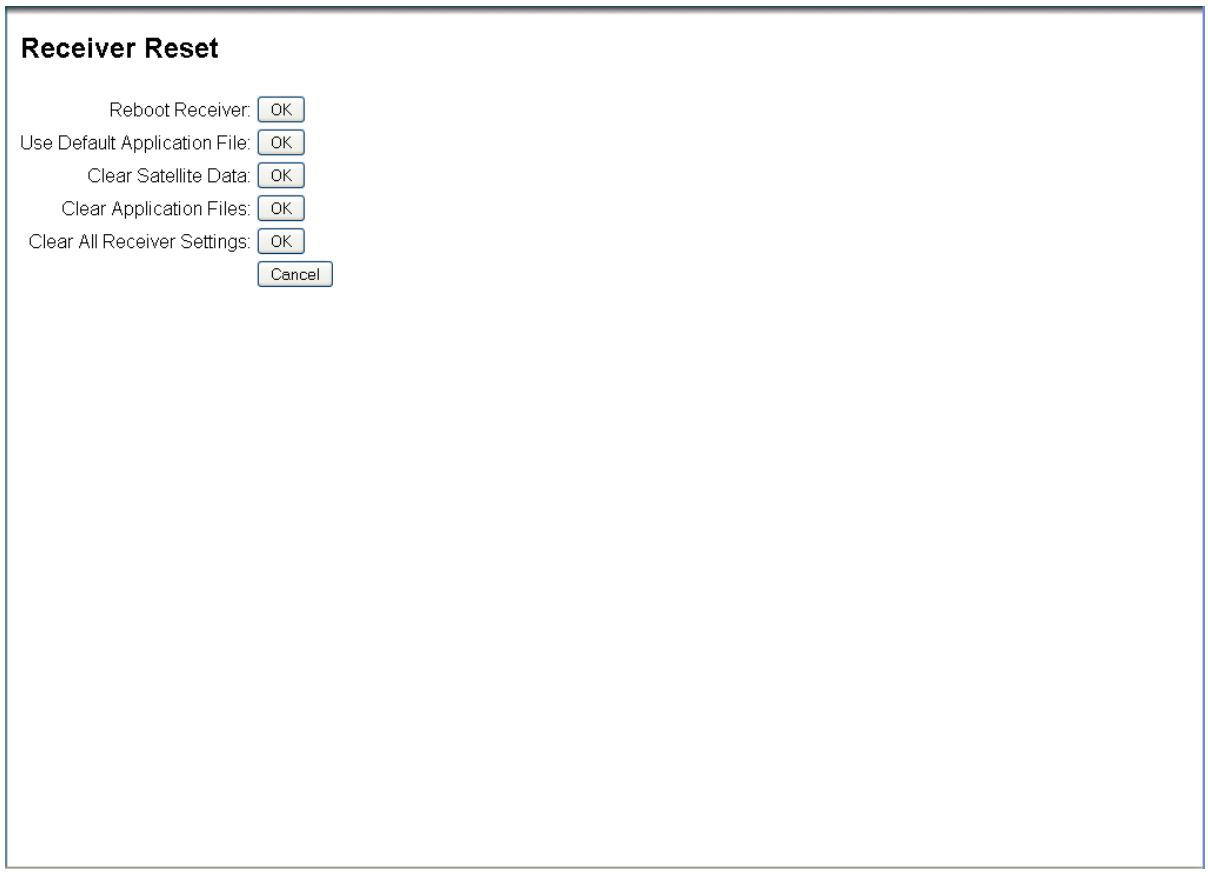


Figure 33 9200-G2 Receiver Reset screen

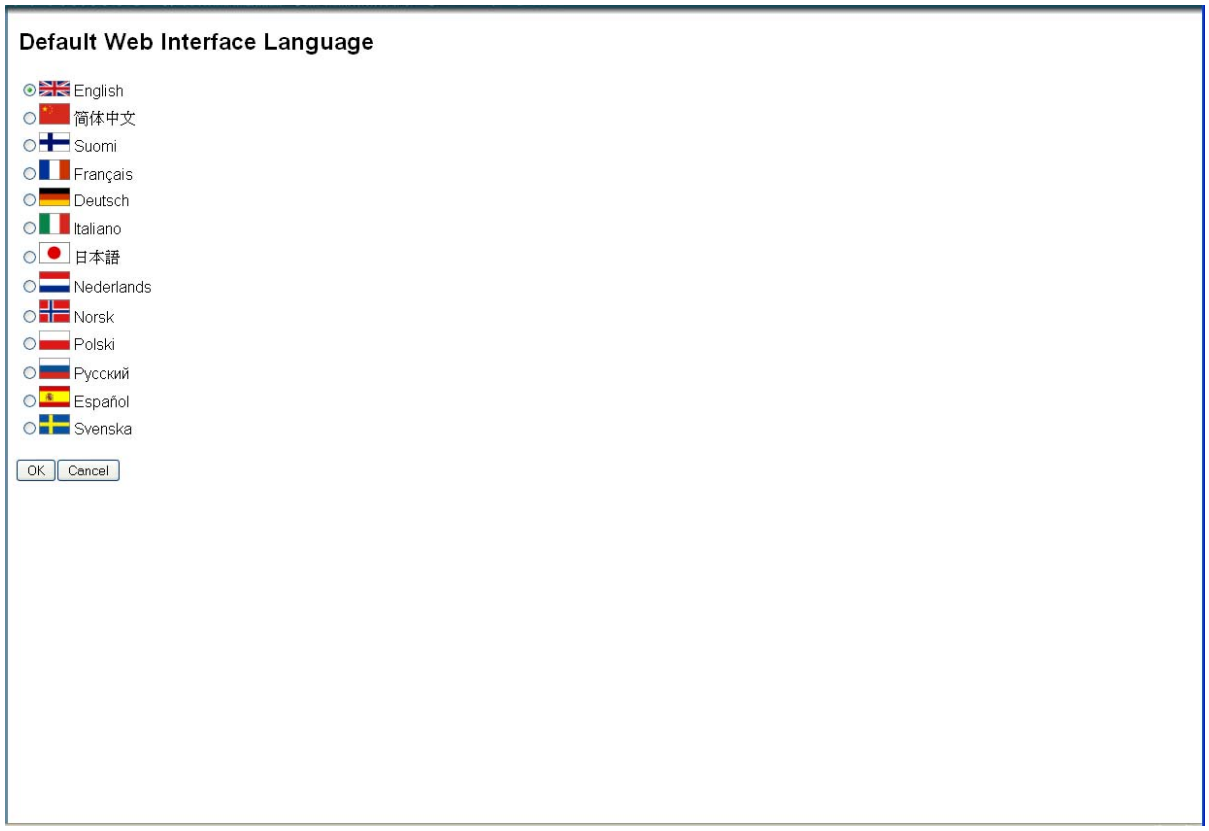


Figure 34 9200-G2 Default interface language screen

I/O Configuration

The I/O Configuration (Port Summary) screen (Figure 35) shows the settings and output streams of all available communication ports (TCP/IP, NTRIP, RS232/CAN and Bluetooth). Except for the RS232 and CAN outputs which do not require/provide a 'connection status feedback' to the receiver, the colour of the table rows indicates whether the port input or output is currently active (green) or inactive (red). The I/O Configuration contains one other submenu item called Port Configuration. This submenu can also be reached by clicking the corresponding port type indication (first column) in the Port Summary screen.

The port configuration screen allows the user to individually select output messages and message output frequencies for every communication port available. However, the total combined amount of output messages over all ports simultaneously is limited to 20.

The port configuration screen also allows the user to change the way the receiver reports the DGNSS quality and age of data. Because some older hardware is unable to recognize GNSS quality indicators other than 0 (no GNSS position), 1 (GNSS standalone position) and 2 (DGNSS position), an SeaSTAR HP, XP or G2 position (normally reported as quality 5) can be reported as being 'just' a DGNSS position (quality 2). It is also possible to control the behaviour of the GGA output message. By default, the GGA and RMC messages are configured to keep the total line length below 80 characters in order to comply with the original NMEA-0183 standard. Unfortunately, this limits the resolution with which the position is reported to approximately 2 cm. When 'extended information' is enabled, the best available position resolution (approximately 0.02 mm) is used, but as a result, the message line length will exceed 80 characters.

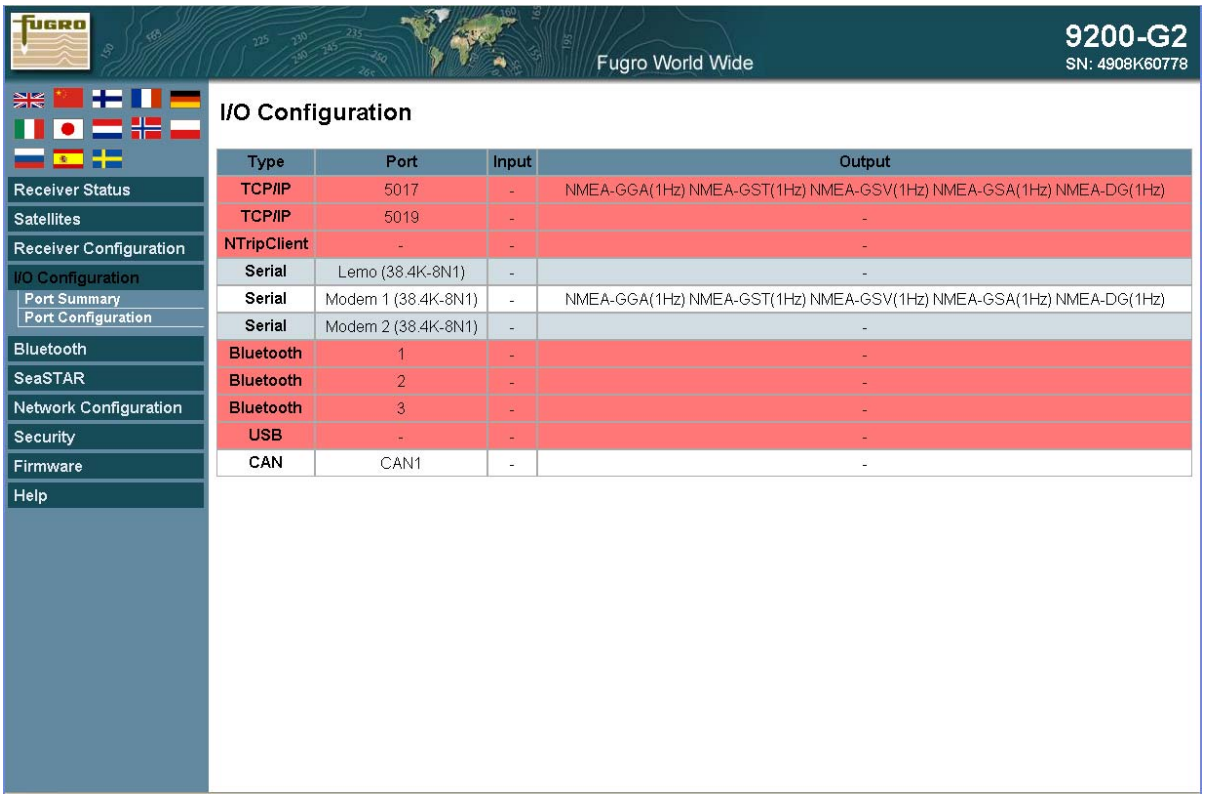


Figure 35 9200-G2 I/O Port Summary screen.

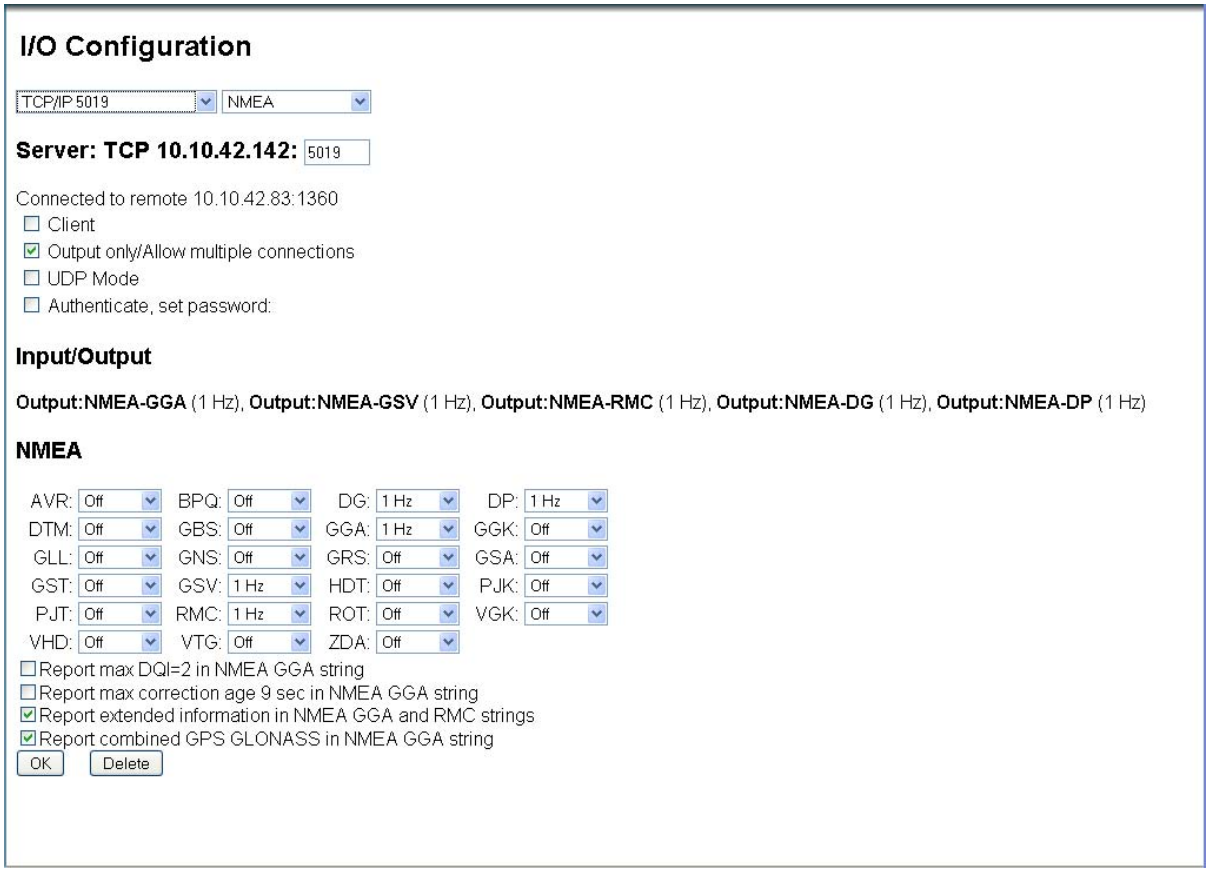


Figure 36 9200-G2 I/O port configuration screen.

Bluetooth

The 9200-G2 receiver is equipped with a Bluetooth module that is able to handle 3 simultaneous connections with other Bluetooth devices. The Bluetooth configuration screens allow the user to view the Bluetooth settings (information screen, see Figure 37), to enable or disable visibility of the receiver for other Bluetooth devices and set the connection PIN code (Configuration screen, see Figure 38) and to view the currently active connections and connection modes (‘Remotes’ screen, see Figure 39).

The 9200-G2s Bluetooth ports can be used as a ‘normal’ COM port to output GNSS position data to a Bluetooth-capable datalogging device, as a modem connection for, for example, NTRIP data in combination with a suitable mobile phone or even a point-to-point network connection, which will allow any suitable Bluetooth-capable device to access the receiver’s web interface, even when a ‘normal’ RJ45 Ethernet connection is not available. For a description on how to connect to a variety of devices using Bluetooth, see Appendix D.

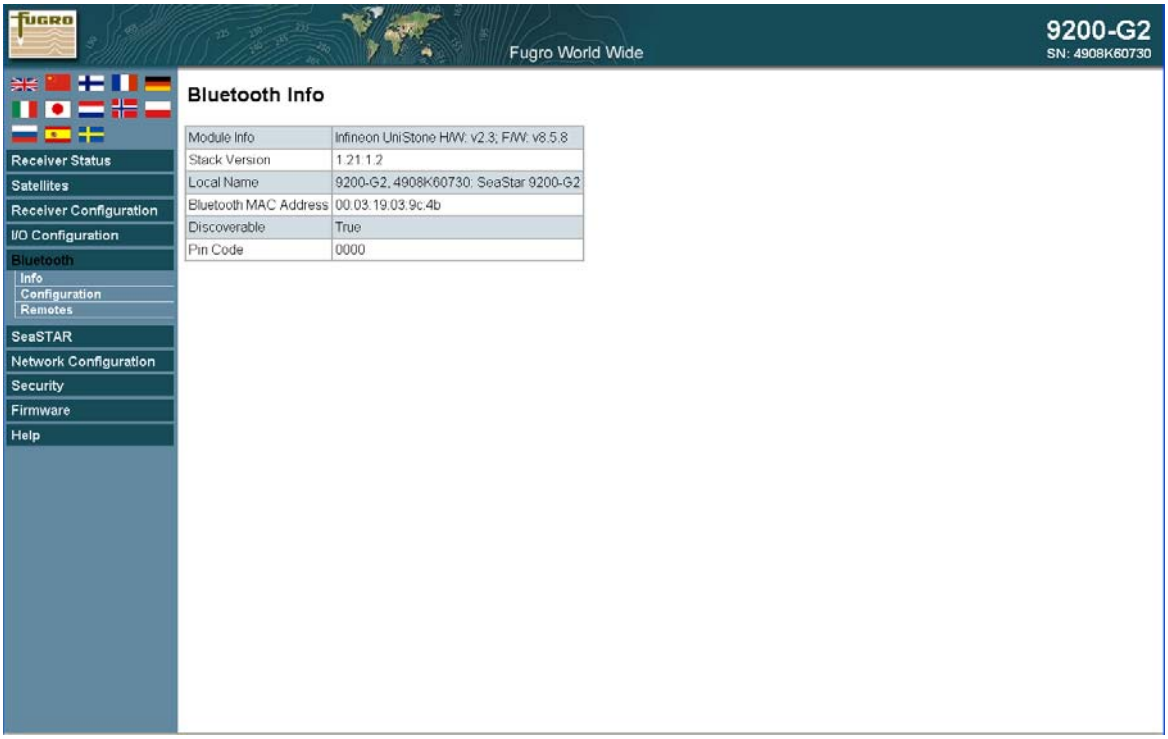


Figure 37 9200-G2 Bluetooth information

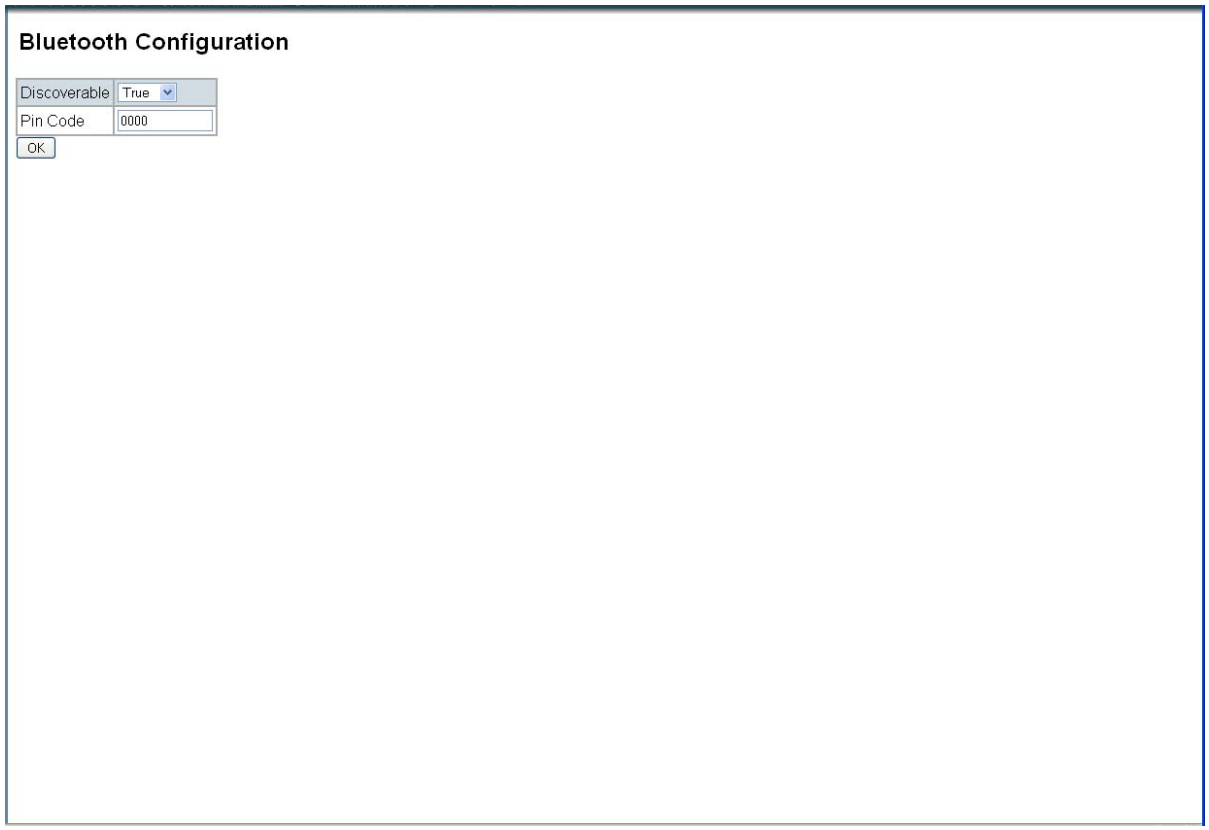


Figure 38 9200-G2 Bluetooth Configuration

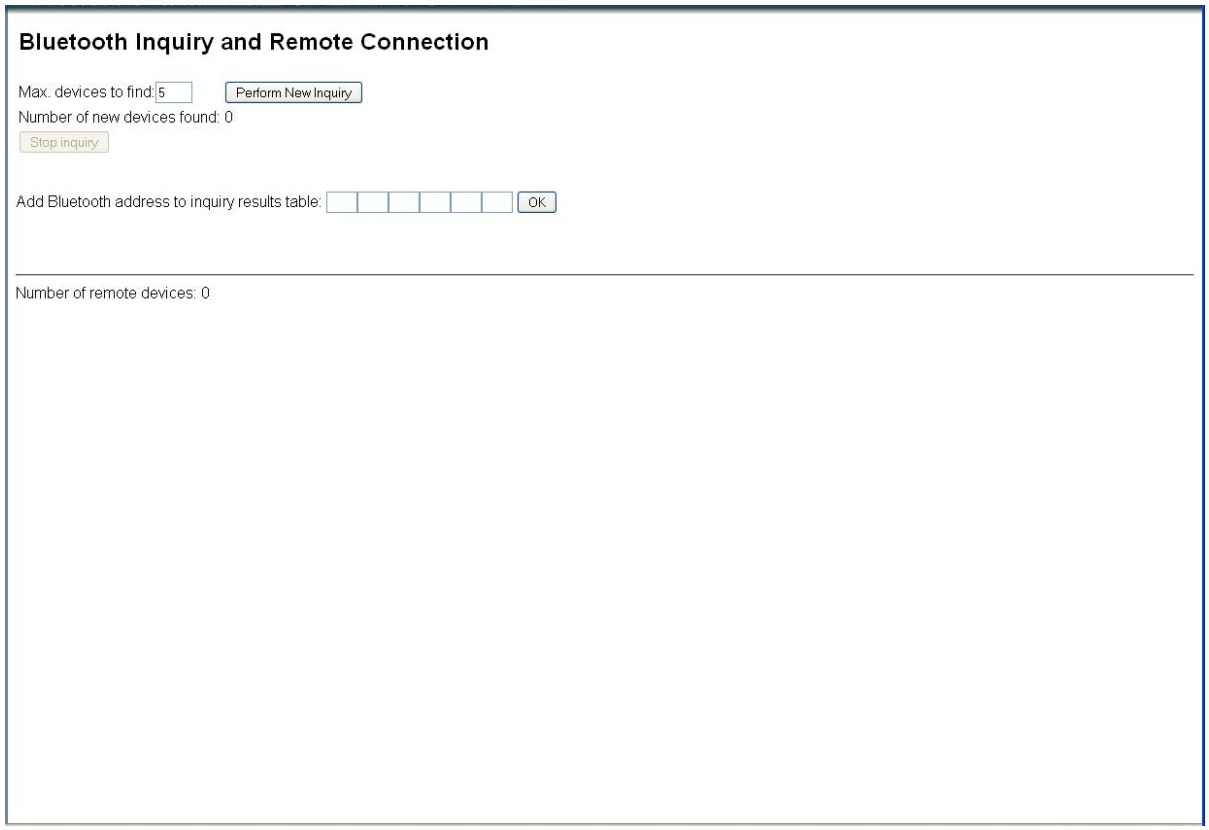


Figure 39 9200-G2 active Bluetooth connections

SeaSTAR

The SeaSTAR menu screens will provide information about the SeaSTAR beam used and the SeaSTAR subscription status of the 9200-G2. The Summary screen (see Figure 40) provides information about the SeaSTAR beam currently tracked/used. The following submenus can also be accessed from the left-hand side menu:

* Configuration — The configuration screen enables the user to specify which SeaSTAR signal can/may be used by the 9200-G2 receiver
* Subscription — The subscription screen provides information about the SeaSTAR expiration dates for both HP/XP/G2 and VBS, the current SeaSTAR HP and VBS engines running inside the receiver and, most importantly, the SeaSTAR serial number of the receiver. Without the proper serial number, the receiver cannot be activated by SeaSTAR
* SeaSTAR status — SeaSTAR Status provides a one-screen overview of the SeaSTAR configuration, the SeaSTAR correction beam status, the HP/XP/G2 library status and settings and the VBS library status.

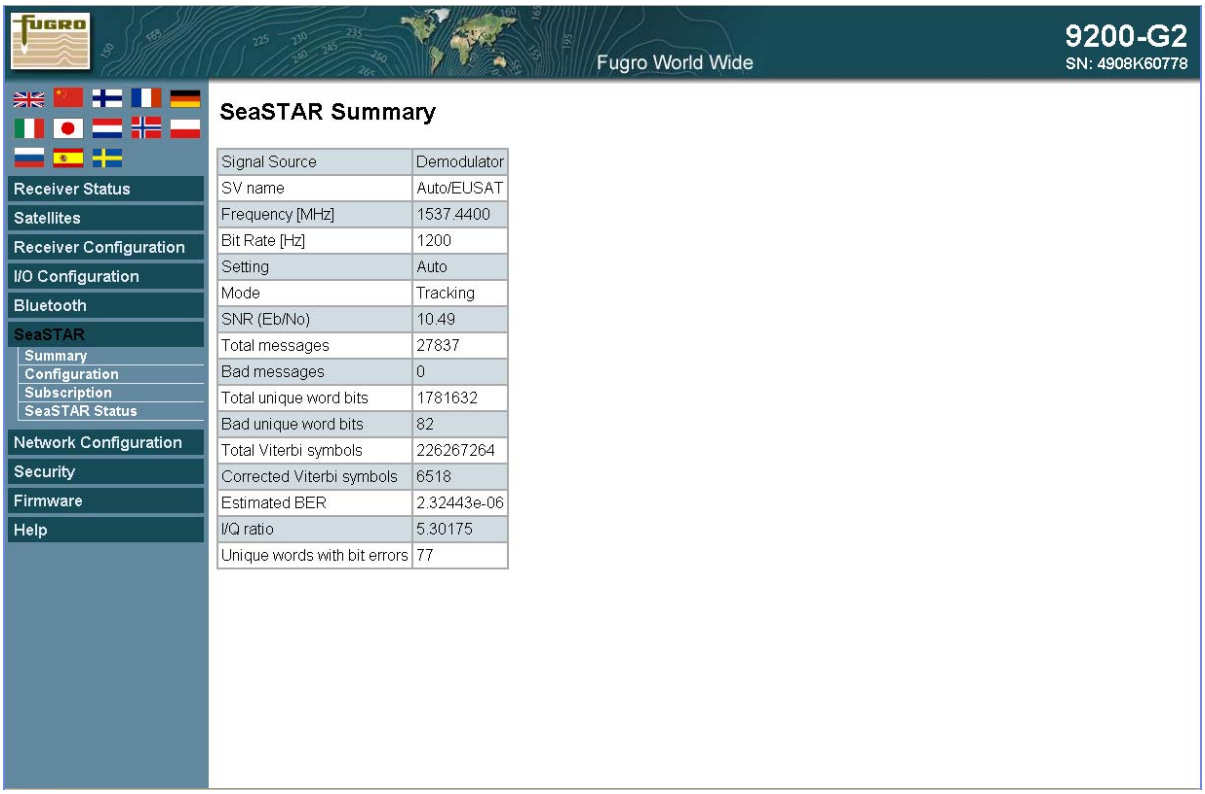


Figure 40 SeaSTAR summary information

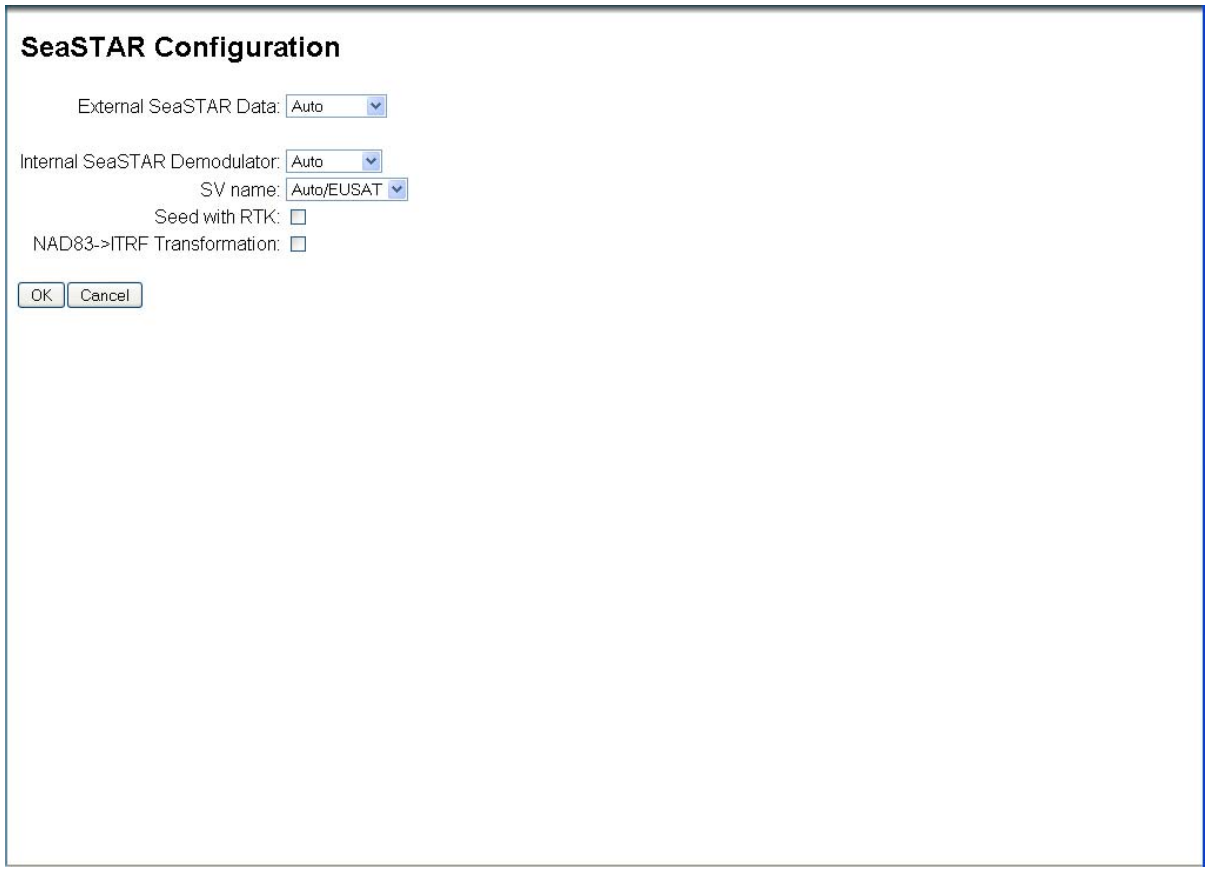


Figure 41 SeaSTAR configuration settings

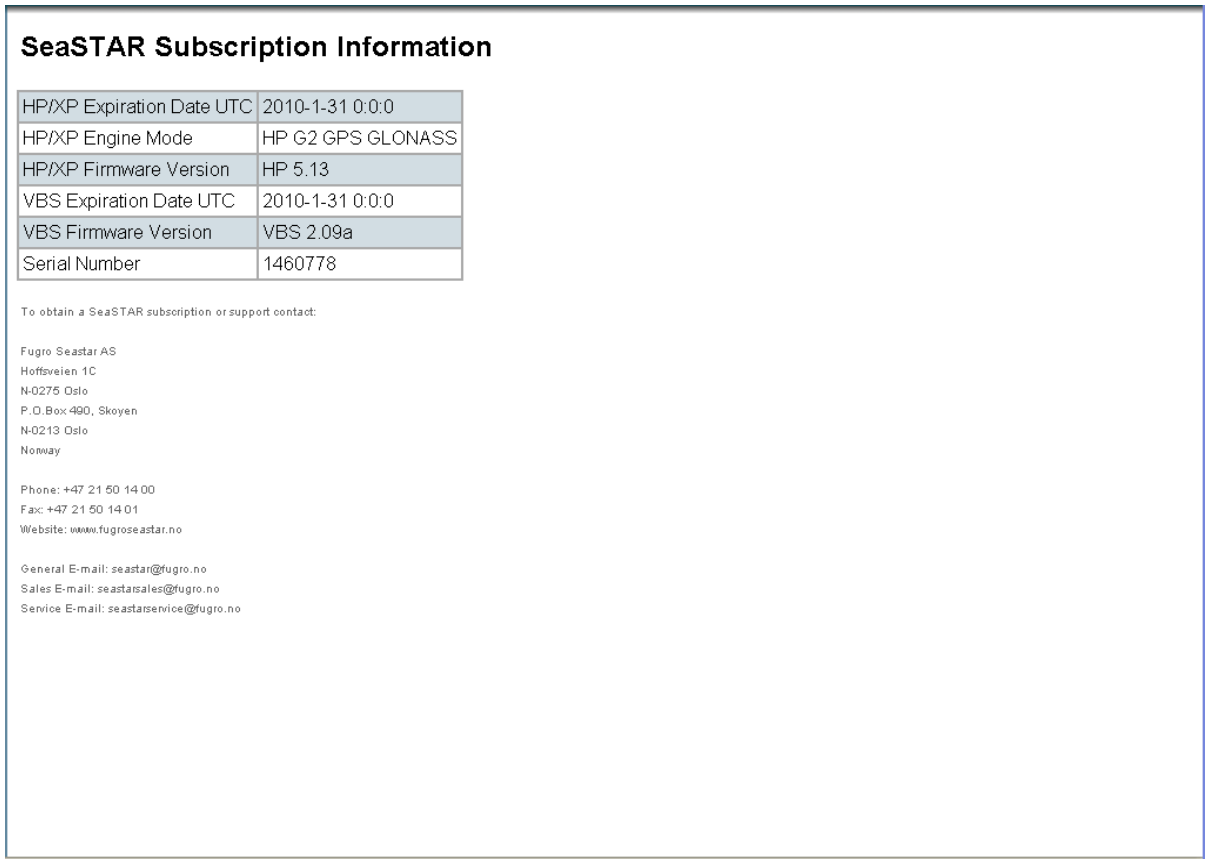


Figure 42 SeaSTAR subscription information

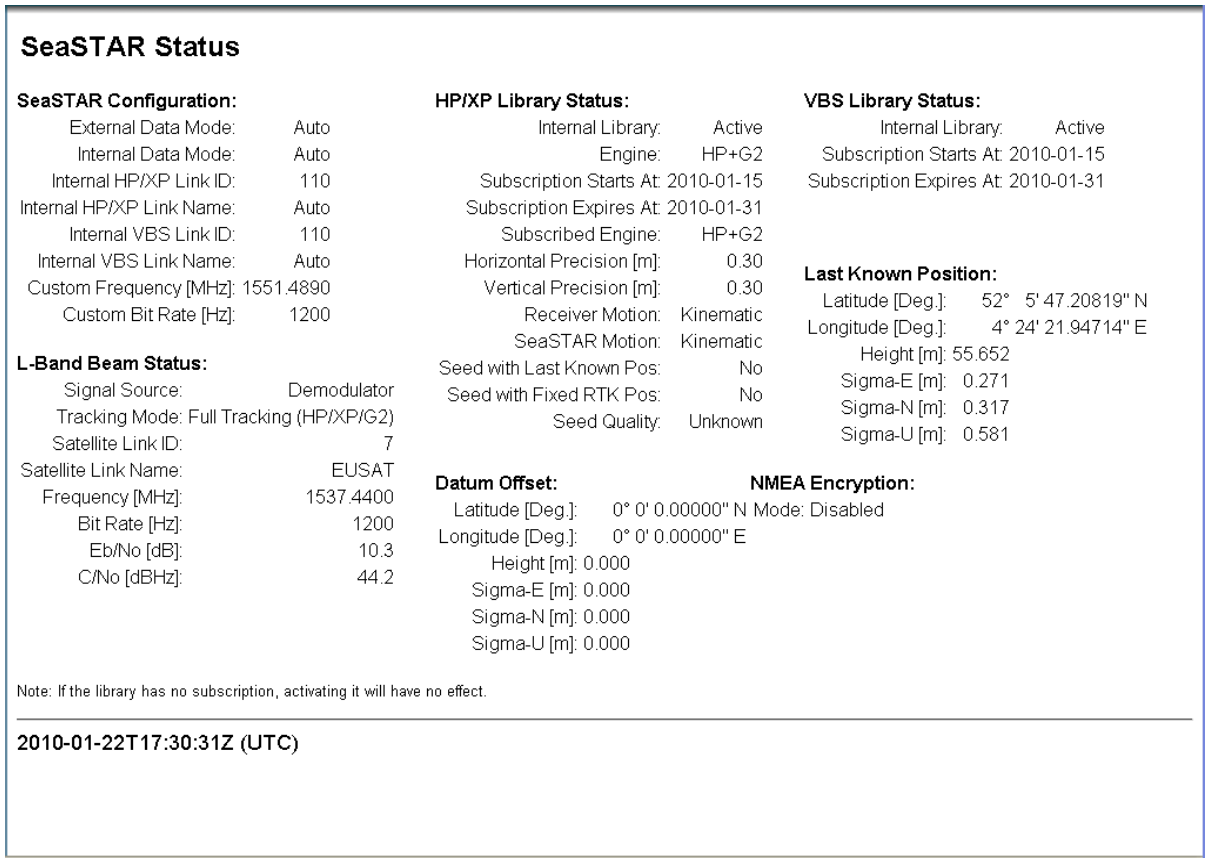


Figure 43 SeaSTAR status information

Network Configuration

The Network Configuration menu screens will provide information about and allows adjustment of the TCP/IP Ethernet connections of the 9200-G2. The Summary screen (see Figure 44) provides information about the currently connected Ethernet network. The following submenus can also be accessed from the left-hand side menu:

* Ethernet — The Ethernet configuration screen provides a complete setup of the TCP/IP Ethernet settings of the 9200-G2. The top half of the screen shows all currently configurable settings, the bottom half of the screen will show the current receiver settings. When the receiver is configured to be a DHCP client (default setting), most of the fields in the top half of the screen cannot be modified by the user and will be filled in automatically with the information obtained from the DHCP server.
* PPP — The PPP screen shows the settings and status of all available PPP (Point-to point protocol) connections from/to the 9200-G2 receiver. Examples of PPP connections are Bluetooth connections between a computer and the 9200-G2 (TCP/IP over Bluetooth) and NTRIP connections using a Bluetooth-capable mobile phone.
* Routing Table — The routing table provides information about the active data connections of the 9200-G2 receiver
* E-Mail Client — The E-Mail Client screen is used to enter the account credentials the receiver may use in order to be able to send e-mail messages.
* E-Mail Alerts — The E-Mail Alerts screen is used to configure the receiver for sending e-mail alert messages whenever a certain event takes place. The types of events/incidents the receiver should send a message about can be chosen from a list.

*	HTTP	The HTTP screen allows the user to change the server port number of the 9200-G2 (default 80). You might want to change the port number when you are behind a firewall/gateway (i.e. only one external IP address) and when you are already running another web server that needs to be available externally.
*	Proxy	The Proxy screen allows the user to enable/disable the use of an http proxy server, which may be necessary in some (company) networks.
*	NTP	Although probably not really necessary since GNSS is providing accurate timing, the 9200-G2 can be configured to obtain accurate time over the internet from up to three different time servers (NTP client). The receiver may also be configured to act as an NTP server, providing accurate timing for all NTP clients within the local network.
*	VFD	The VFD Server screen allows for enabling/disabling the remote display functionality of the 9200-G2 receiver over Ethernet (disabled by default).
*	DDNS Client	The DDNS configuration screen allows for use of the 9200-G2 receiver in combination with a DDNS (Dynamic Domain Name Service) server. When the external IP address of the receiver is not fixed, a DDNS server may help accessing the receiver remotely without having to remember its IP address.
*	Zeroconf/UPnP	The Zero Configuration / UPnP screen allows for 'Universal Plug and Play' configuration, which will allow easy detection and configuration in UPnP enabled networks.

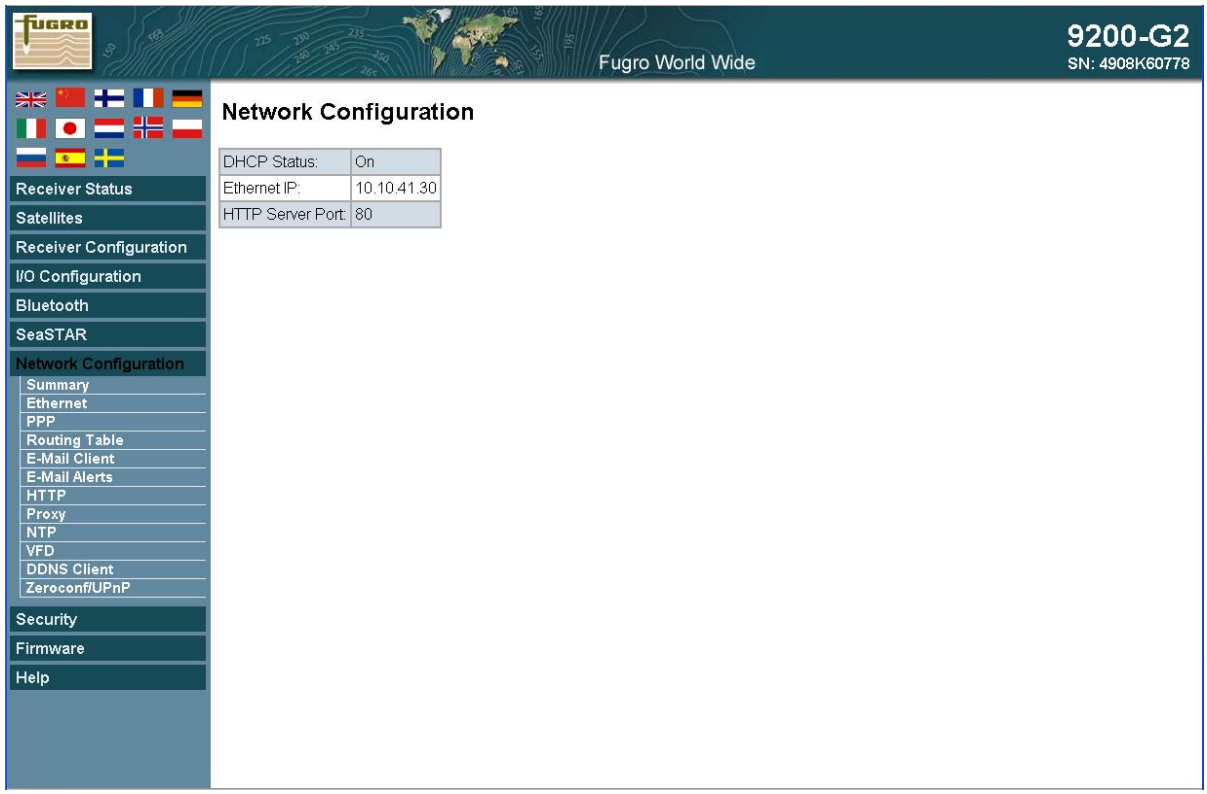


Figure 44 Network information screen

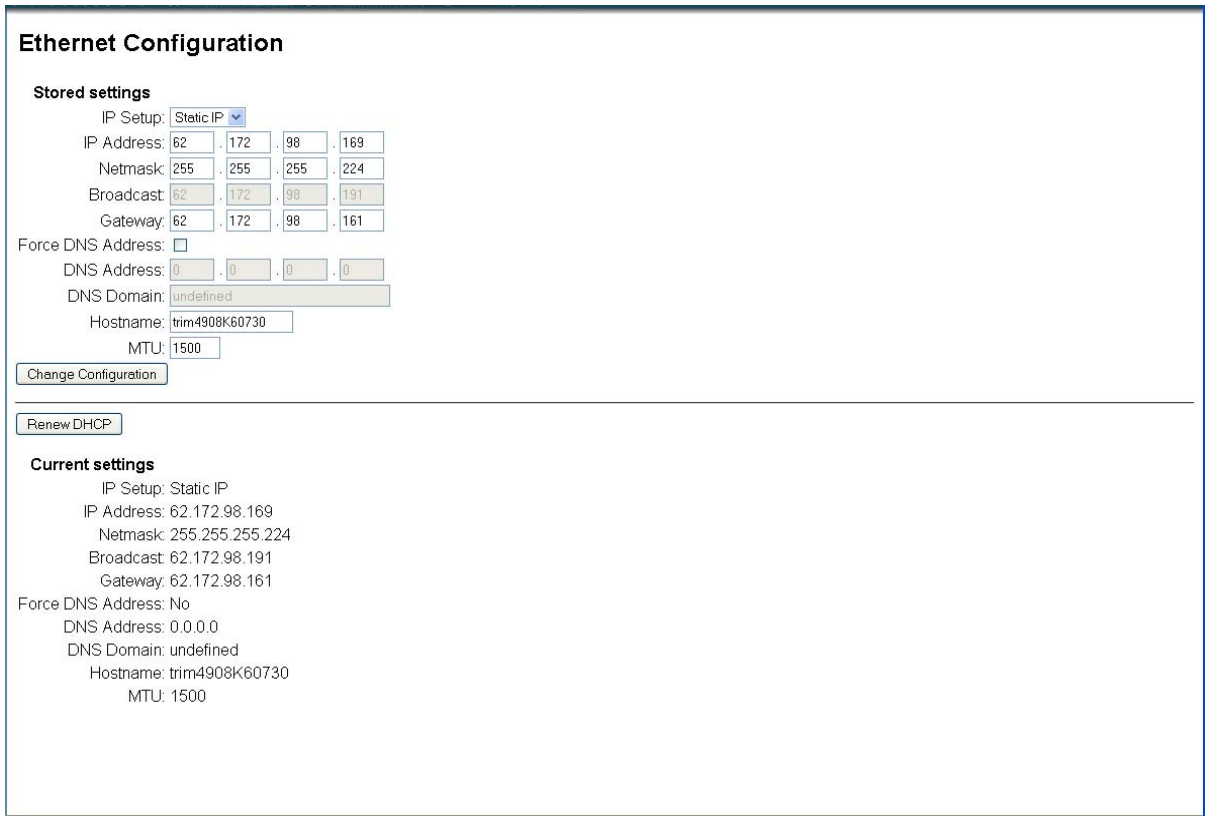


Figure 45 Ethernet configuration settings and overview

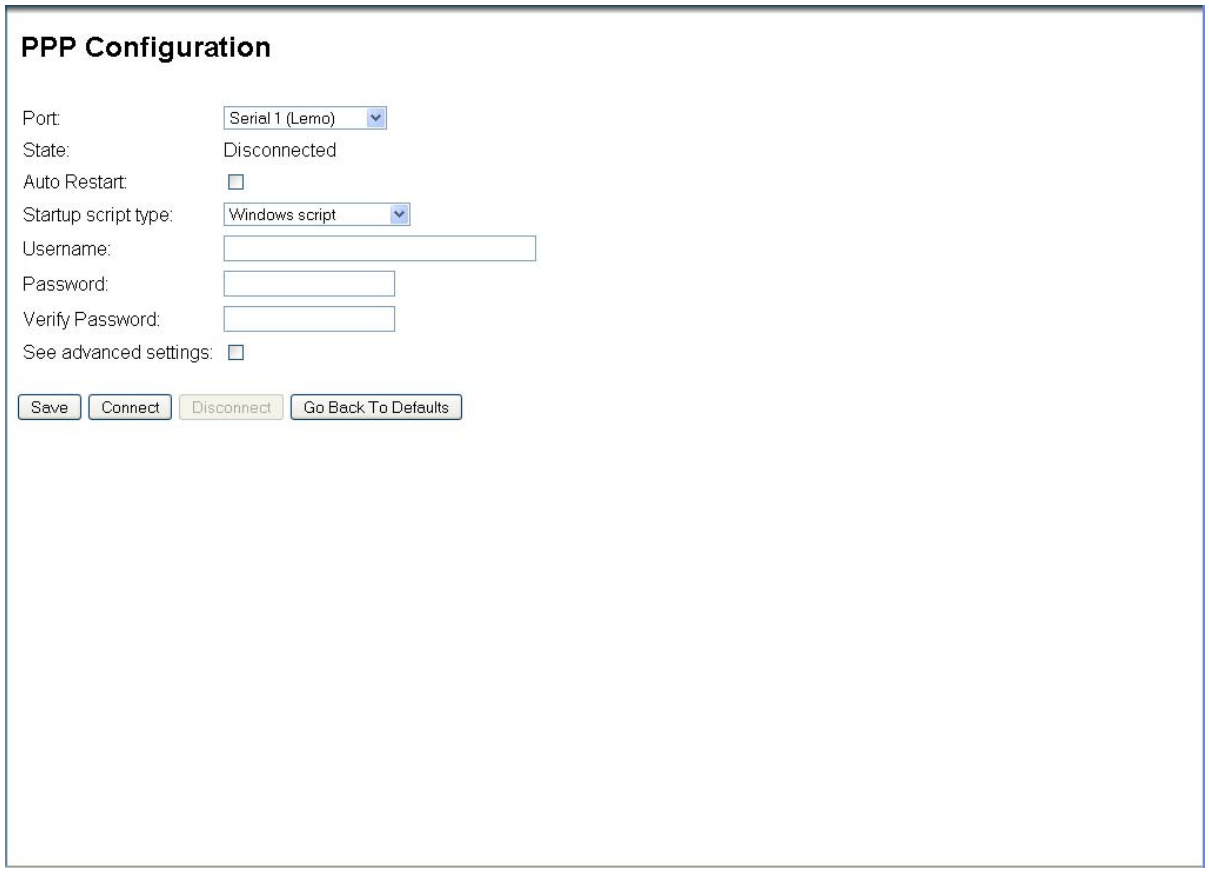


Figure 46 PPP configuration settings

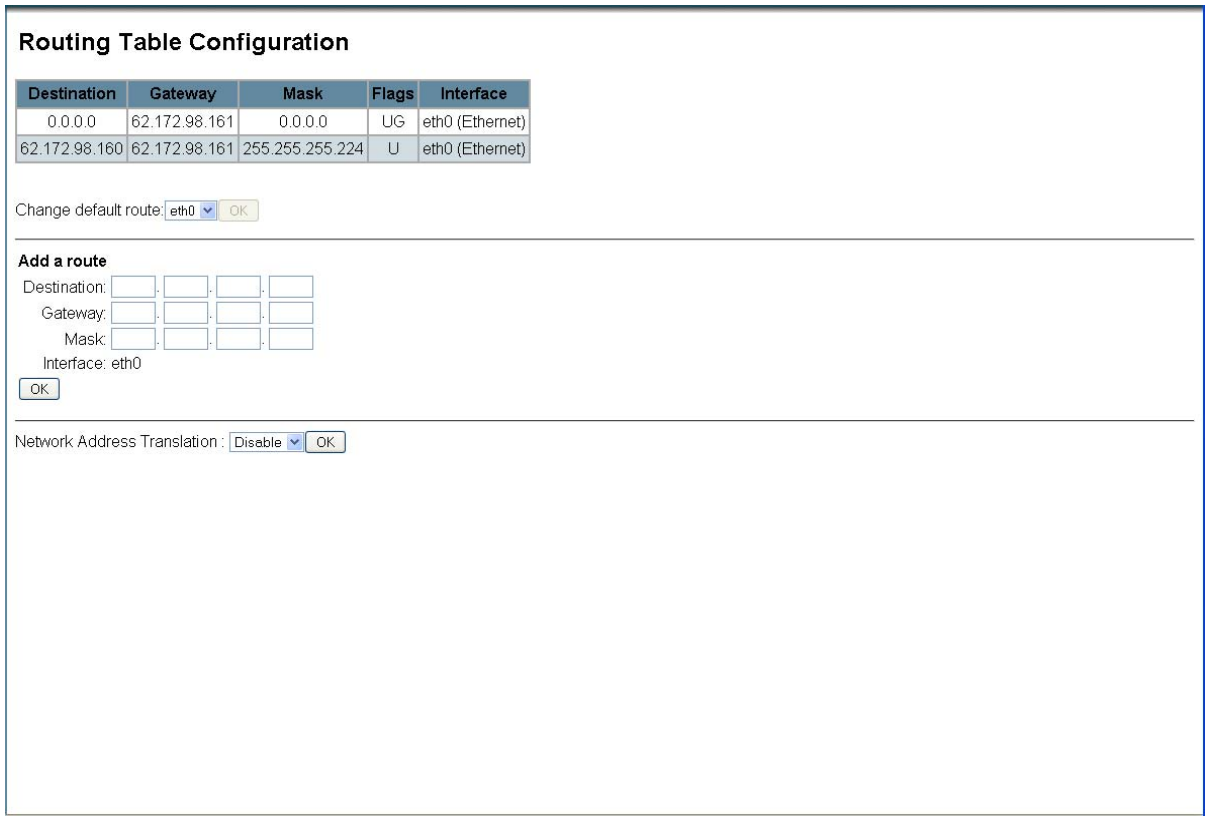


Figure 47 TCP/IP routing information

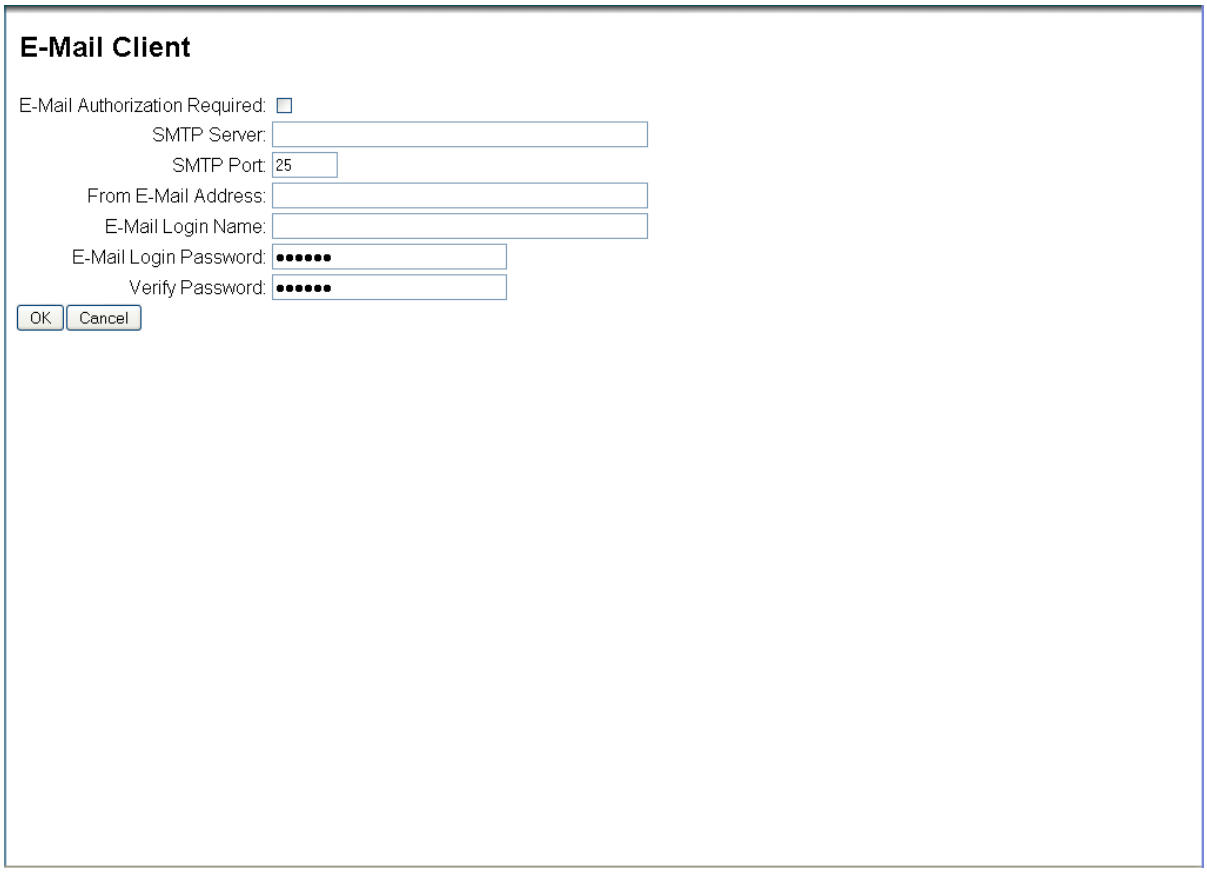


Figure 48 9200-G2 E-Mail Client settings

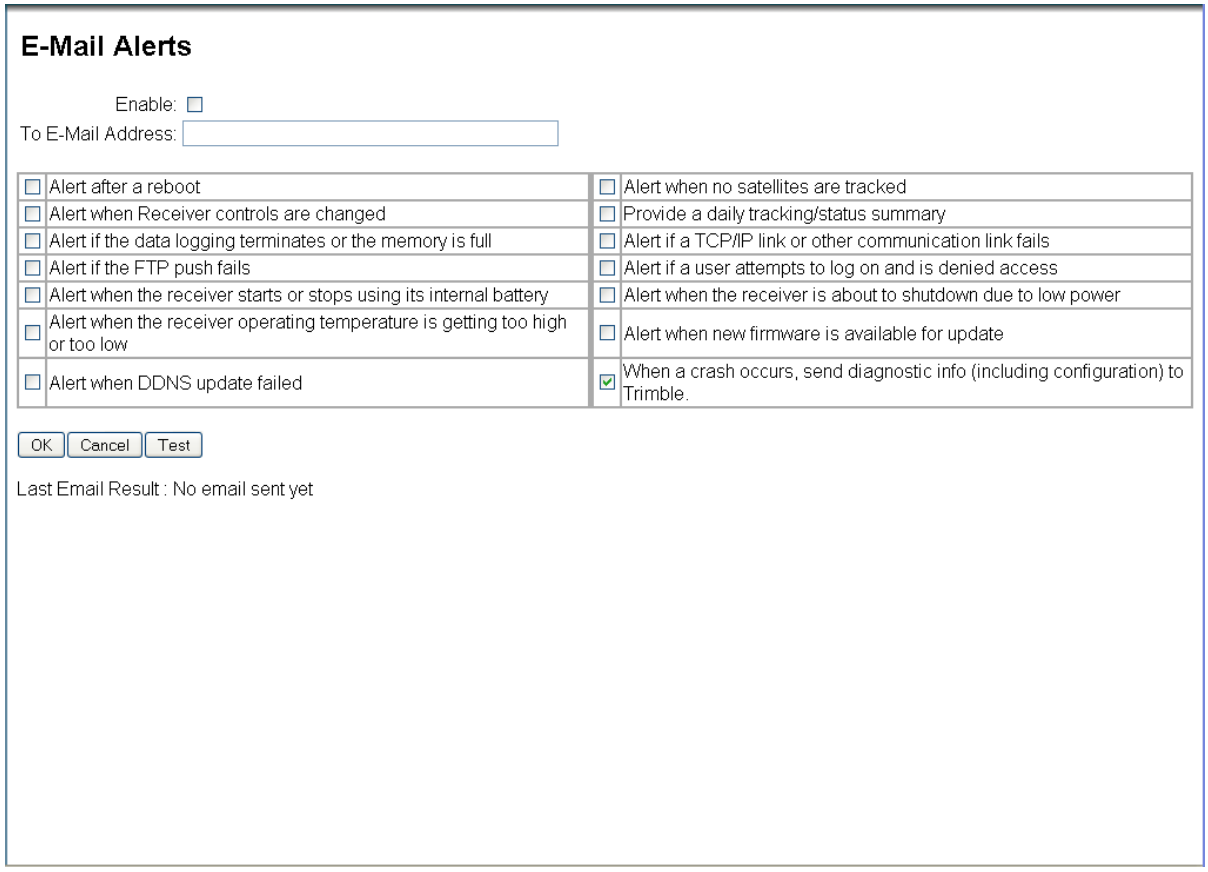


Figure 49 9200-G2 E-Mail Alerts settings

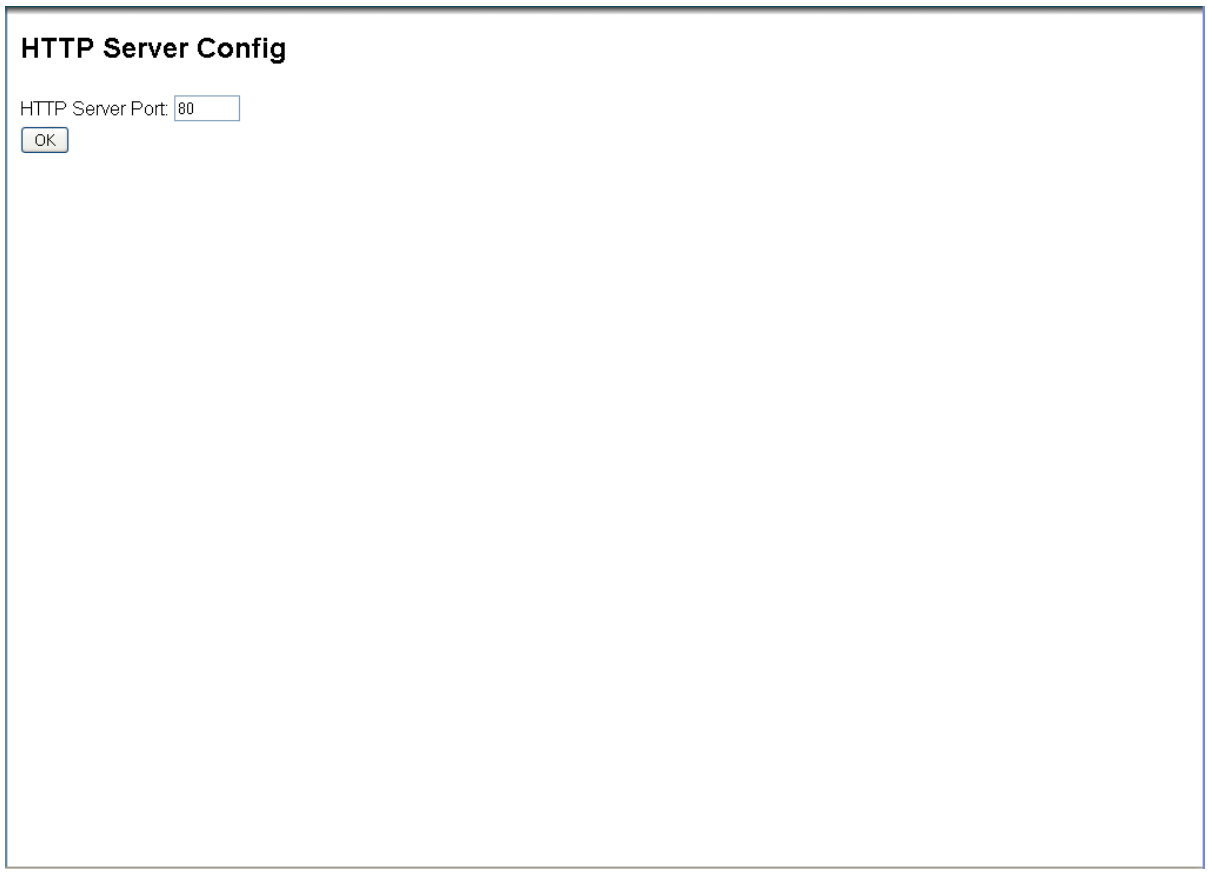


Figure 50 9200-G2 HTTP server setting

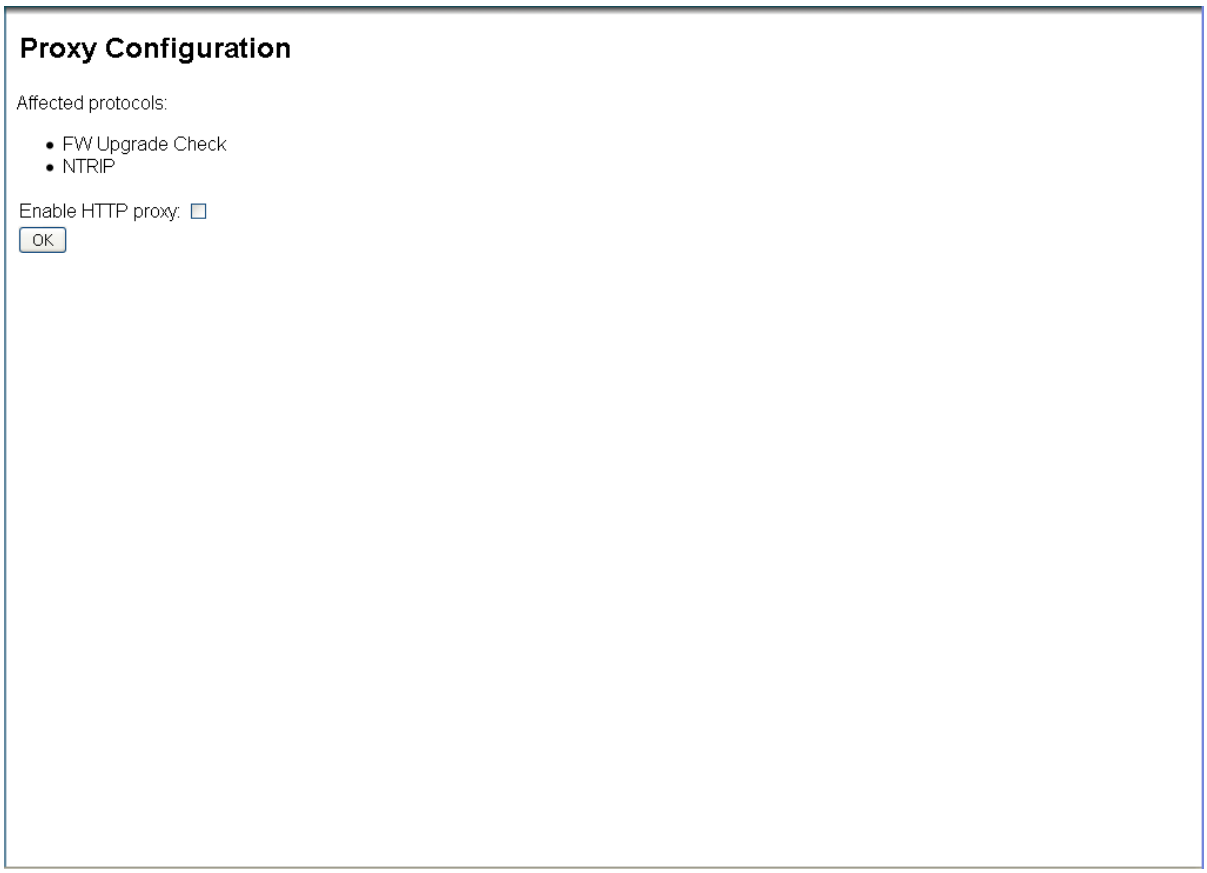


Figure 51 9200-G2 HTTP Proxy Configuration

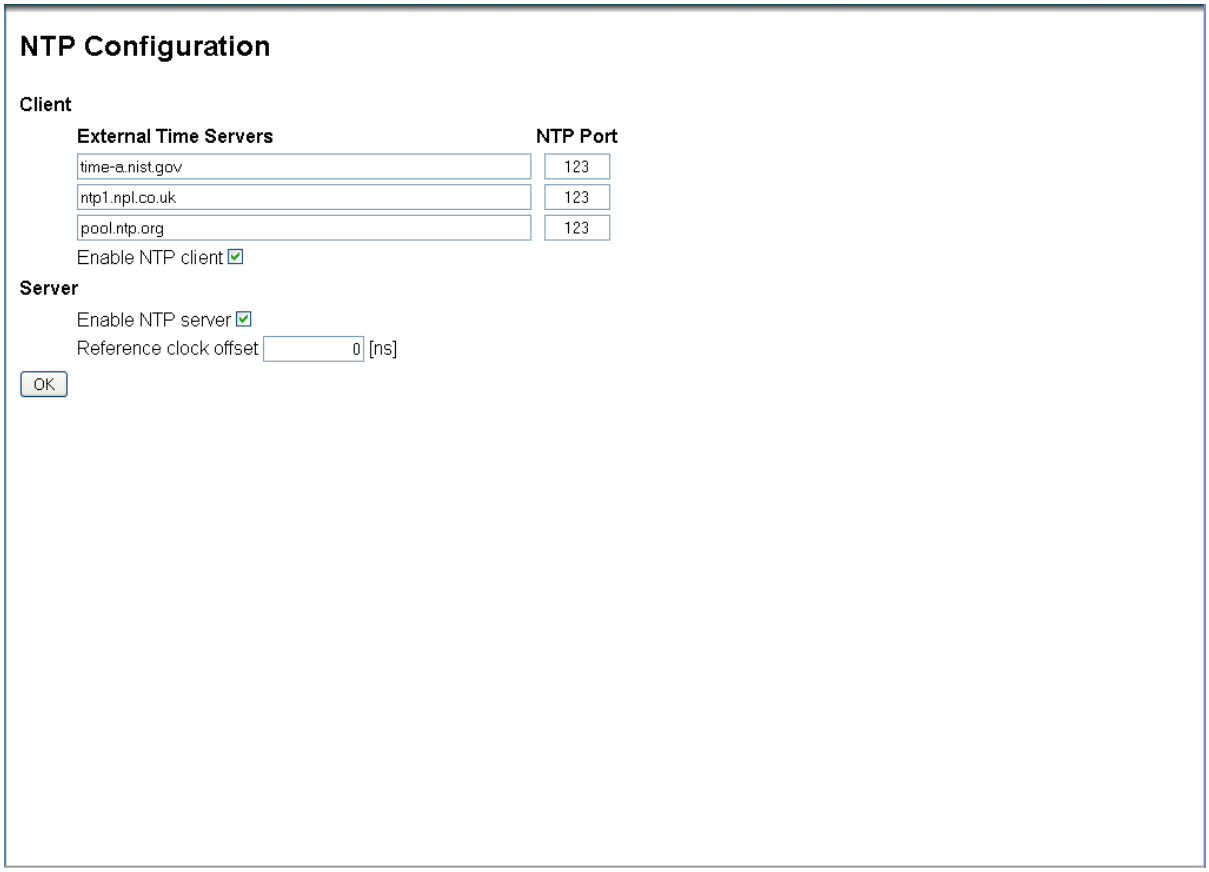


Figure 52 9200-G2 NTP (time-server) configuration

Figure 53 9200-G2 VFD Server settings

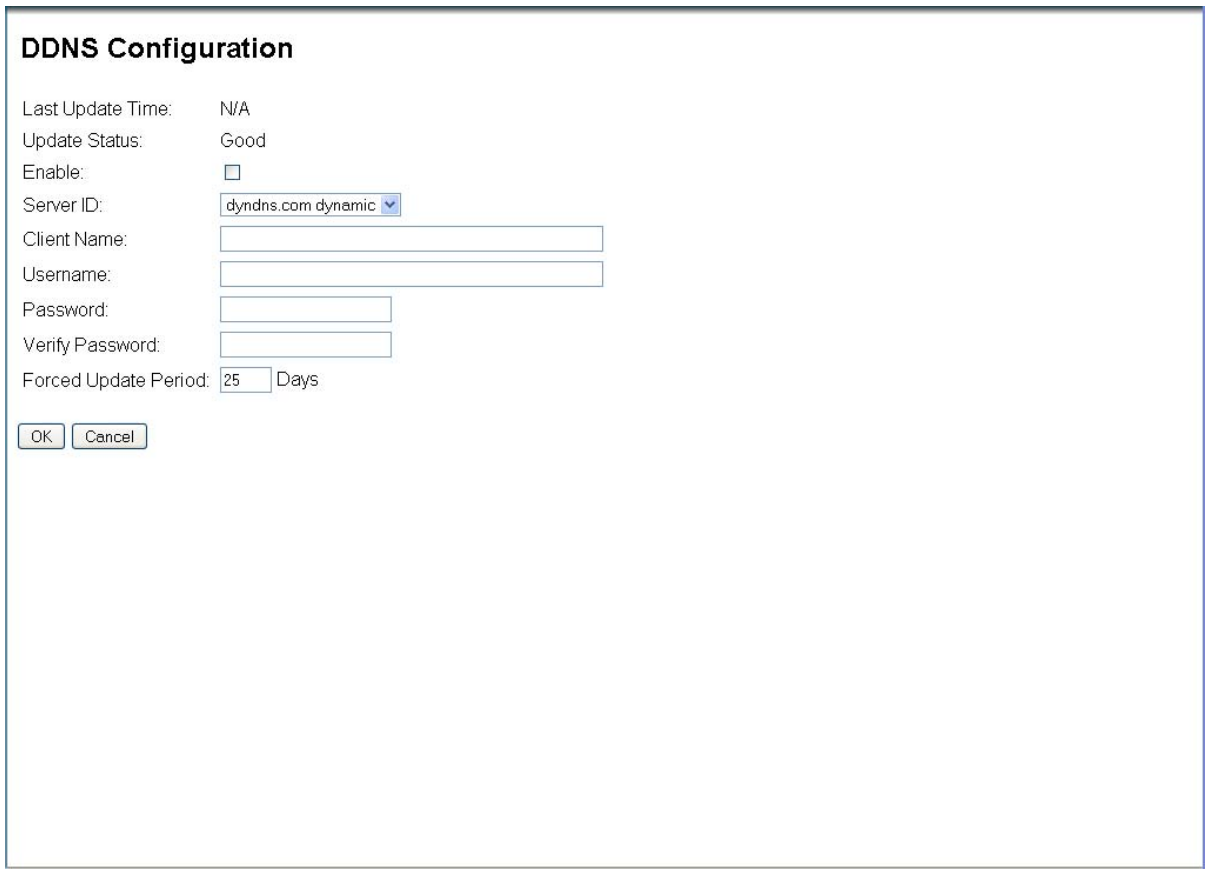


Figure 54 9200-G2 DDNS settings

Figure 55 9200-G2 DDNS settings

Security

Using the security menu, users can be added to or deleted from the allowed users database and passwords for all users can be set/changed. Since the default user and password combination are the same for all 9200-G2 receivers, it is good security practice at least to change the default password, especially when the receiver will be accessible from the Internet.

The Summary screen (see Figure 56) provides an overview of all the users in the receiver's database and their operating rights. The Configuration screen (Figure 57) allows adding and deleting of users and setting the operational rights of the various users. One exception: the default user 'admin' cannot be deleted. The 'Change Password' screen (Figure 58) allows changing of passwords for all known users.

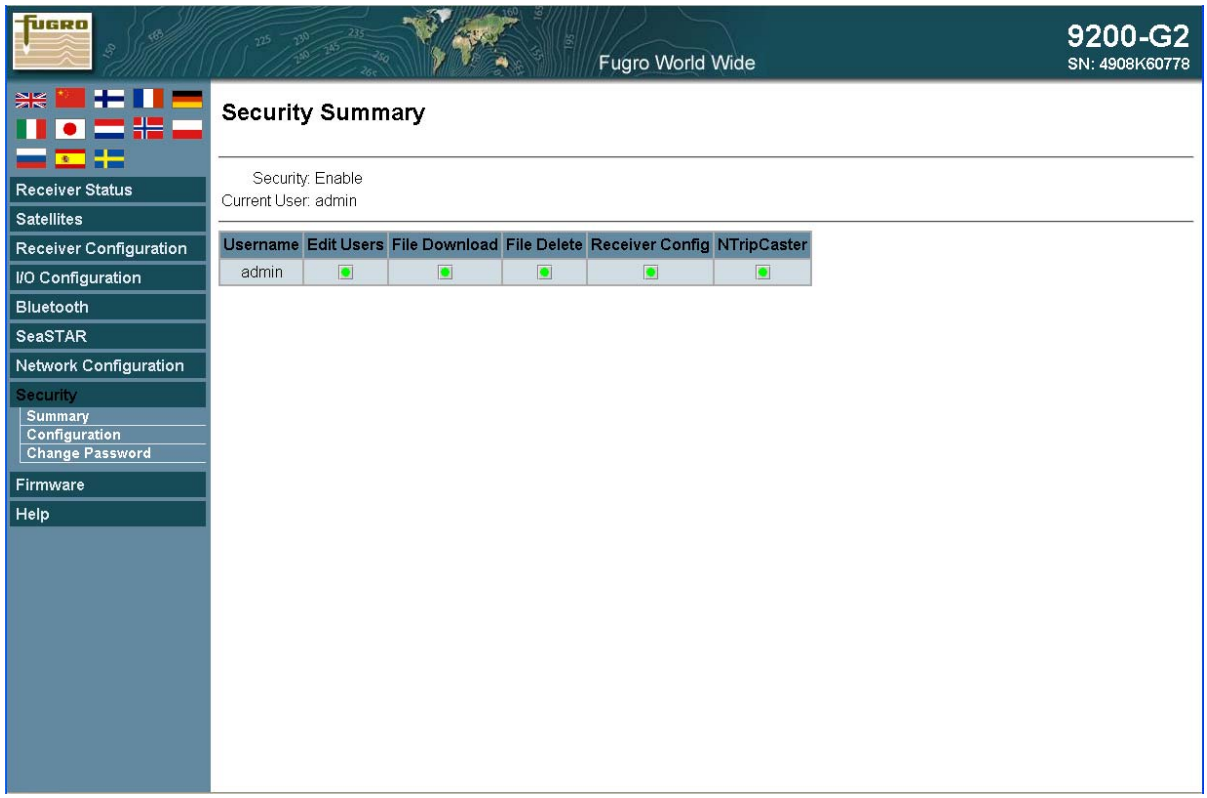


Figure 56 9200-G2 security summary

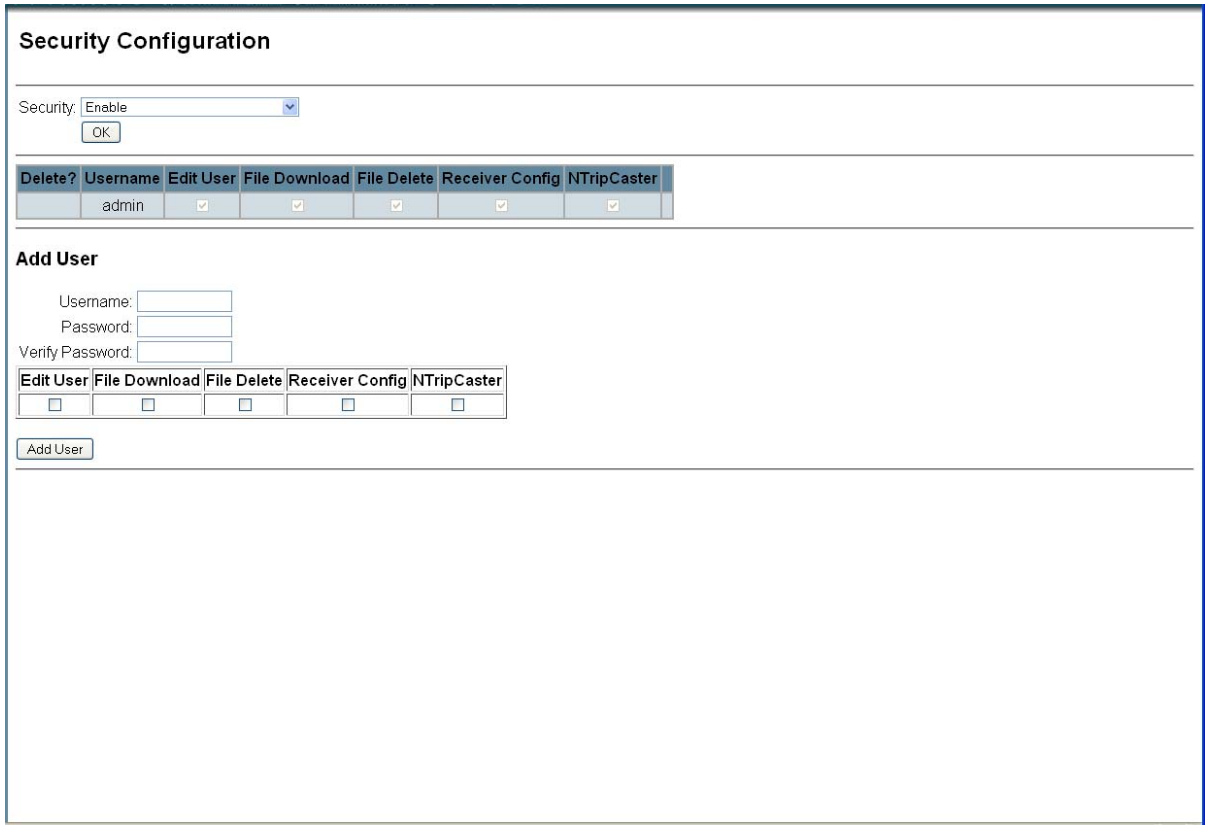


Figure 57 9200-G2 security configuration

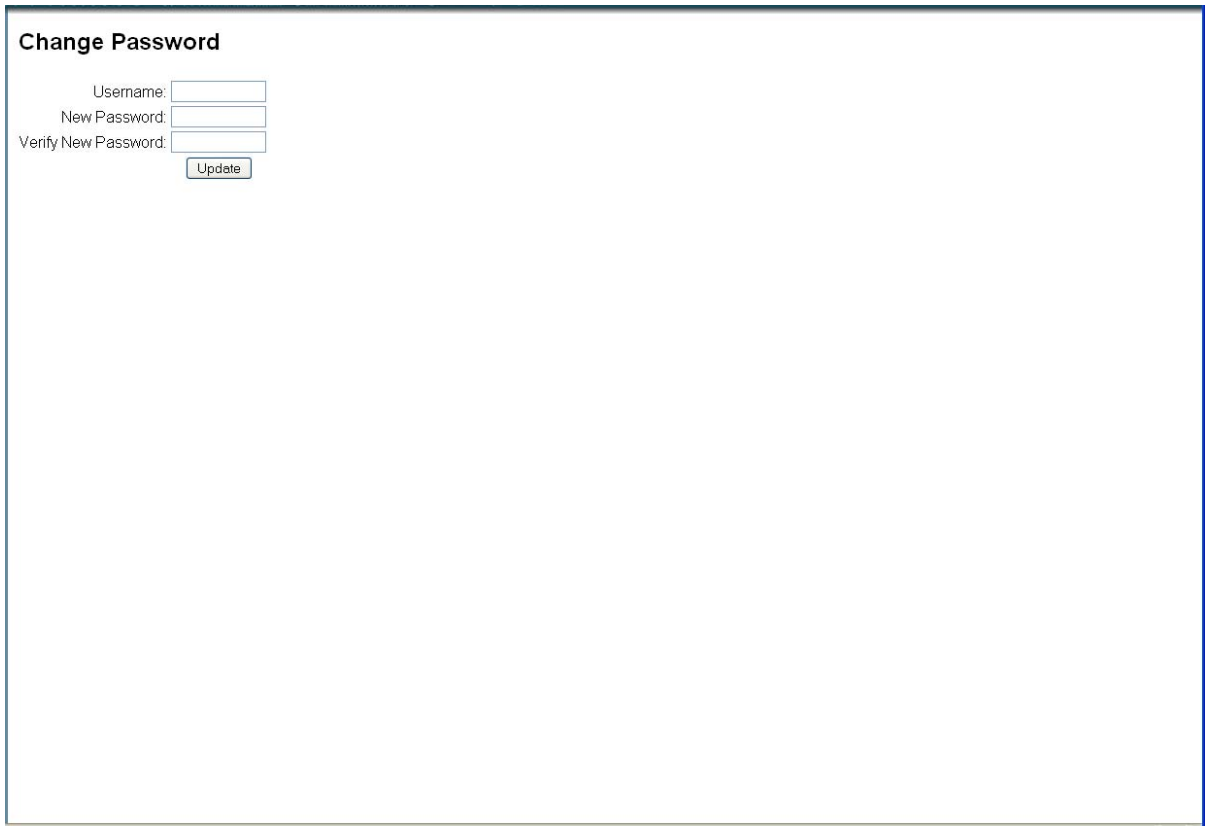


Figure 58 9200-G2 change password

Firmware

The firmware of the 9200-G2 can be easily upgraded using the web interface. The Firmware menu (Figure 59) shows the currently active firmware and allows for uploading and installing new firmware, which is available through the SeaSTAR website. To install new firmware, first click the ‘Browse’ button. A new window will open allowing you to search for the new firmware image on any of the drives inside or attached to your computer. When you have located the correct file, click the ‘Install New Firmware’ button and follow the on-screen directions. Uploading and installing new firmware typically takes between 5 and 10 minutes.

The FW Upgrade Check screen (Figure 60) allows the user to configure the receiver to automatically check the internet for a newer version of the firmware. When a newer firmware version is available, the receiver will show a notification. It can also send out an e-mail alert, when enabled (see also the E-Mail Alerts screen (Figure 49) on page 45).

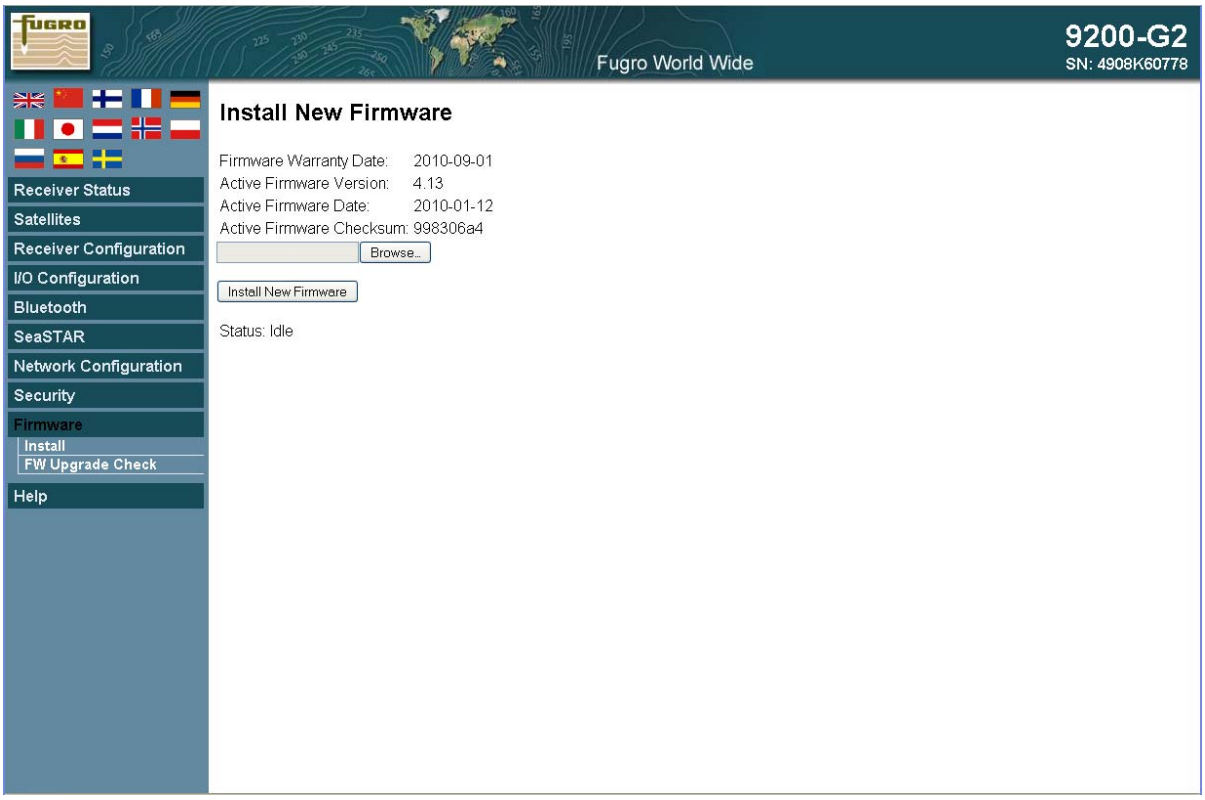


Figure 59 9200-G2 Firmware update screen

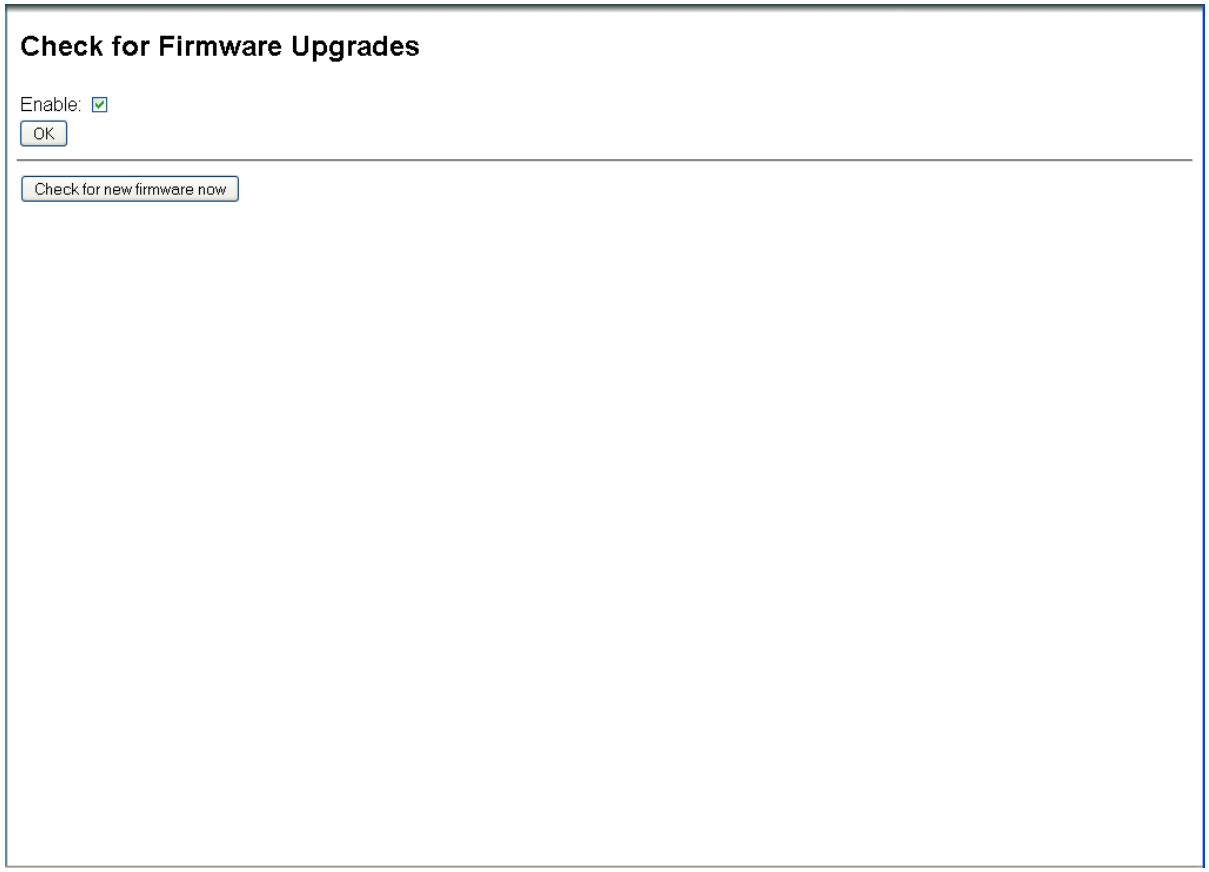


Figure 60 9200-G2 Firmware upgrade check

Help

The help screen (Figure 61) allows the user to download the system log, a binary file containing a list of all receiver events. This list may help in troubleshooting the receiver when it is not operating the way it is supposed to.
The acknowledgements screen (Figure 62) shows the persons responsible for (parts of) the receiver web interface.

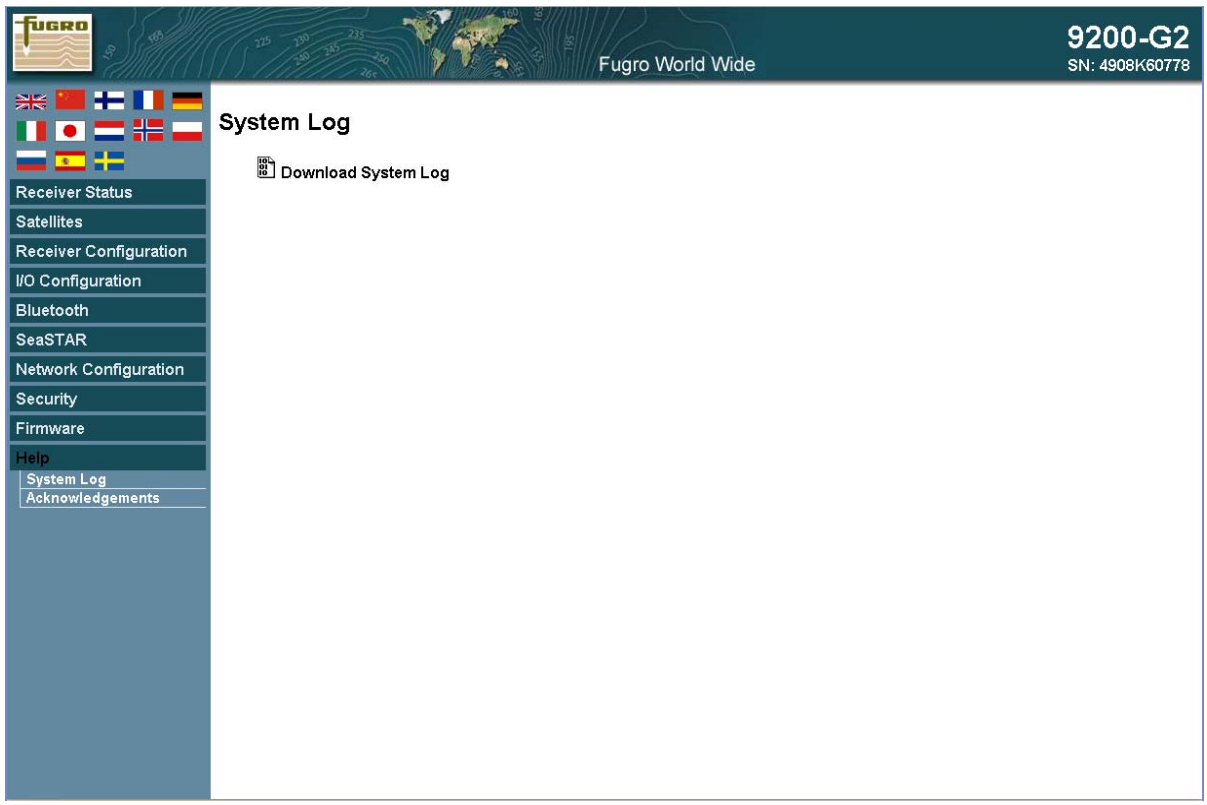


Figure 61 9200-G2 system log

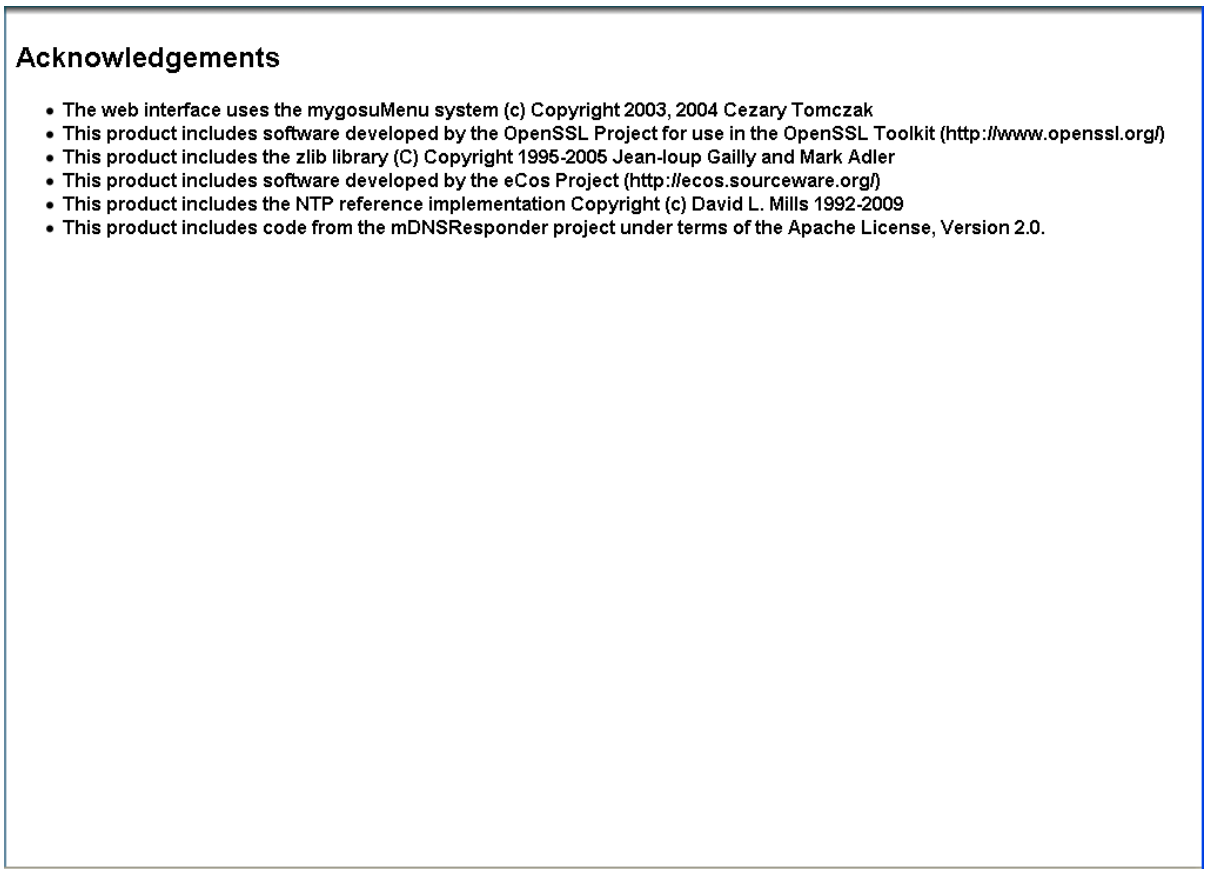


Figure 62 9200-G2 acknowledgements screen

Appendix A

Technical Specifications

Performance

Position Accuracy [1]	VBS: 0.80 m 2DRMS HP: 0.10 m 2DRMS XP/G2: 0.15 m 2DRMS
Reacquisition	<5 s L1 (typical) <5 s L2 (typical)
Data Rates	1, 2, 5 and 10 Hz
Time Accuracy [1 2]	40 ns RMS
Velocity Accuracy	0.05 m/s RMS
Geoidal model	OSU91a (10x10 degree resolution, WGS84 DMA, interpolated)
Dynamics	Vibration 4.5 G (sustained tracking) Maximum Velocity 50 m/s [3,4] Maximum Height 18.288 m [3]

Environmental

Operating Temperature	-40°C to +65°C
Storage Temperature	-40°C to +80°C
Humidity	MIL-STD 810F, Method 507.4
Waterproof	IP67 for submersion to a depth of 1 meter

Power requirements

Voltage	+15 to +28 VDC
Power consumption	6 W (typical)

[1] Typical values. Performance specifications are subject to GPS system characteristics, U.S. DOD operational degradation, Ionospheric and Tropospheric conditions, satellite geometry, baseline length and multipath effects.
[2] Time accuracy does not include biases due to RF or antenna delay.
[3] In accordance with export licensing.
[4] Although the receiver is technically capable of higher speeds, the operational speed of a SeaSTAR subscription is limited to 50 m/s.

RF input

Antenna connector	TNC female, 50 Ω nominal impedance
RF Input Frequencies	1575 MHz (GPS L1), 1227 MHz (GPS L2), 1602 MHz (GLONASS L1), 1246 MHz (GLONASS L2), 1525 MHz – 1559 MHz (SeaSTAR L-Band)

Input / output data interface

Electrical Format	RS232 / CAN / TCP/IP / Bluetooth
Bit Rate[1]	2400, 4800, 9600, 19200, 38400, 57600 and 115200 bps (RS232, CAN and Bluetooth) 230400, 460800 and 921600 bps (Bluetooth) Up to 100 Mbps (TCP/IP)

Output ports

7-pin OS Lemo	RS232 (3-wire) and CAN
26-pin D-Sub	RS232 (full, through multiport adapter) RS232 (3-wire) 1 PPS (through adapter cable) TCP/IP (through multiport adapter) USB (through multiport adapter)
Bluetooth	fully integrated 2.4GHz Bluetooth radio
Lead output	1 PPS using a suitable multiport adapter cable

Physical dimensions

Size	120 (w) x 50 (h) x 240 mm (d)
Weight	1.55 kg

[1] Most older external hardware using GPS NMEA-messages is set to use 4800 bps, 8 databits, 1 stopbit and no parity (8N1).

Connector pin layout

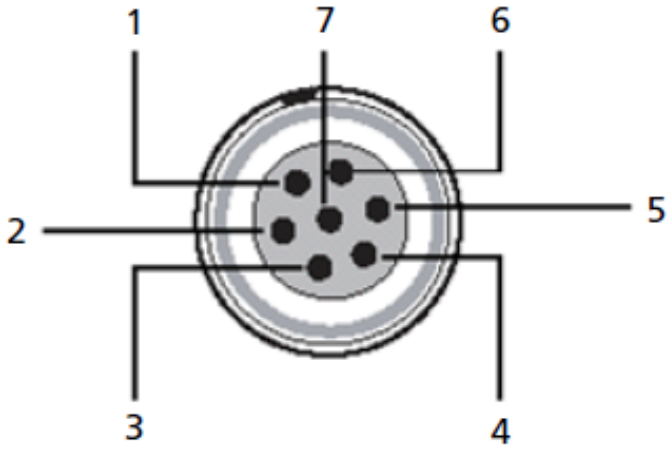


Figure 63: Pin layout (7-pin O-Shell Lemo)

Pin	Usage
1	RS-232 Signal GND
2	GND
3	RS-232 TX Data out
4	CAN-
5	CAN+
6	DC Power in (+) 10.5 – 28 VDC
7	RS-232 RX Data in

Table 2: 9200-G2 7-pin O-Shell Lemo pin layout

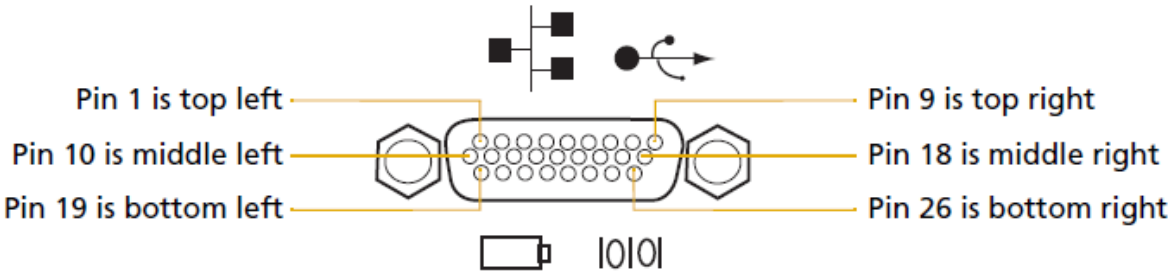


Figure 64: Pin layout (26-pin D-Sub)

Pin	Usage
1	RS-232 Modem 1 port data terminal ready (DTR)
2	RS-232 Modem 1 port clear to send (CTS)
3	RS-232 Modem 1 port Data Set Ready (DSR)
4	RS-232 Modem 1 port Data Carrier Detect (DCD)
5	RS-232 Modem 1 port Ring Indicator (RI)
6	GND
7	RS-232 Modem 2 port Transmit Data (TX)
8	RS-232 Modem 2 port Receive Data (RX)
9	USB+
10	Ethernet Ground (GND, RJ45 Pin4)
11	RS-232 Modem 1 port Ready to Send (RTS)
12	RS-232 Modem 1 port Transmit Data (TX)
13	Ethernet Ground (GND, RJ45 Pin5)
14	Ethernet Ground (GND, RJ45 Pin8)
15	USB ID
16	Ethernet Receive Data- (RD-, RJ45 Pin 6)
17	Ethernet Transmit Data- (TD-, RJ45 Pin 2)
18	USB-
19	USB Power
20	1 PPS
21	RS-232 Modem 1 Port Receive Data (RX)
22	Ethernet Ground (GND, RJ45 Pin 7)
23	GND
24	DC Power In 9 – 28 VDC
25	Ethernet Receive Data+ (RD+, RJ45 Pin 3)
26	Ethernet Transmit Data+ (TD+, RJ45 Pin 1)

Table 3: 9200-G2 26-pin D-Sub pin layout

1 PPS and ASCII Time Tag Output

The 9200-G2 receiver can output a 1 pulse-per-second (1PPS) time strobe and an associated time tag message. The time tags are output on a user-selected port.

The leading edge of the pulse coincided with the beginning of each UTC second. The pulse is driven between nominal levels of 0.0 V and 5.0 V (see
Figure 65). The leading edge is positive (rising from 0 V to 5 V).
The pulse is about 8 µs wide, with rise and fall times of about 100 ns. The resolution is approximately 40 ns, but the antenna cable length limits the accuracy of the pulse to approximately ± 1 µs, since each meter of cable adds a delay of about 2 ns to the satellite signals and a corresponding delay in the 1 PPS pulse.

If you have an application that requires 1PPS output, please contact SeaSTAR for a suitable multiconnector adapter cable which will provide 2 DB9 ports (modem 1 and modem 2), the second of which (modem 2) carries the 1PPS on pin 9, a BNC connector for 1 PPS, an Ethernet (RJ45 male) plug for connection to a computer/network, a USB plug and a DC power jack for supplying external power to the receiver.

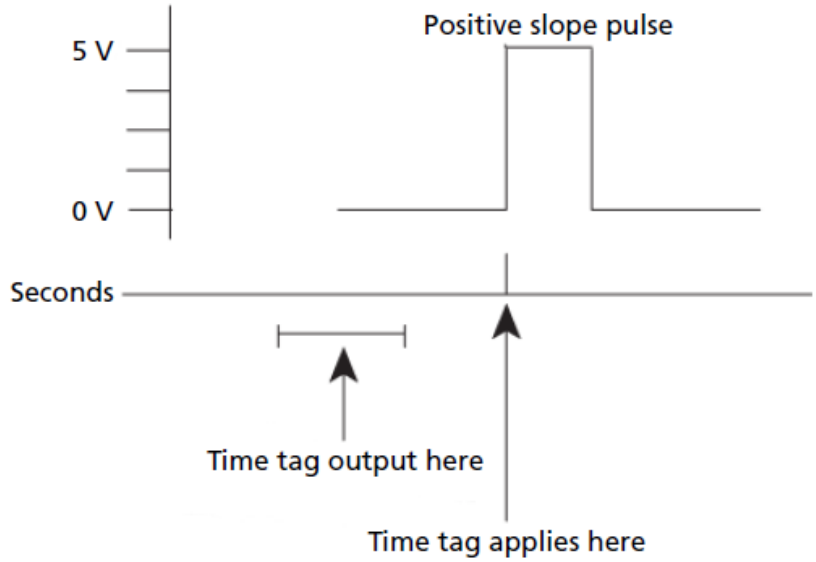


Figure 65: 9200-G2 1 PPS Output pulse

Appendix B

NMEA 0183 Message Options

The SeaSTAR 9200-G2 is capable of outputting a number of NMEA messages. Which messages are output over which port can be selected using either the receiver's front panel interface (see "Mode Settings"on page 13) or the receiver's web interface (see "I/O Configuration" on page 35). The default (pre-selected) value for the output rate is 1 Hz, but 2, 5 and 10 Hz or a number of values lower than 1 Hz may also be selected. Apart from the 'common' NMEA messages (starting with $GP, $GL or $GN), some proprietary vendor-specific messages (starting with $PTNL or $PFUG) can be selected for output.

Message	Function
DTM	Datum reference
GBS	
GGA	Time, position and fix related data
GLL	Latitude, longitude and time data
GNS	
GRS	GNSS range residuals
GSA	GNSS DOP and active satellites
GST	Position error statistics
GSV	Number of SVs in view, PRN, elevation, azimuth and SNR
HDT	Heading from True North
PFUG,DP	Time, position and position error statistics
PTNL,AVR	Time, yaw, tilt, range, mode, PDOP and number of SVs for Moving Baseline RTK
PTNL,BPQ	Base station position and position quality indicator
PTNL,DG	SeaSTAR L-band receiver channel strength
PTNL,GG K	Time, position, position type and DOP values
PTNL,PJK	Local coordinate position output
PTNL,PJT	Receiver datum information
PTNL,VGK	Time, locator vector, type and DOP values
PTNL,VHD	Heading information
RMC	Position, velocity and time
ROT	Rate of Turn
VTG	Actual track made good and speed over ground
ZDA	UTC day, month, year and local time zone offset

Table 4: NMEA 0183 messages available for the 9200-G2

NMEA 0183 Message Formats

In this section each message is described in more detail.

GGA – GNSS Fix Data

The GGA message includes time, position and fix related data for the GNSS receiver.

$GPGGA,hhmmss.ss,ddmm.mmmmm,D,dddmm.mmmmm,D,Q,sv,H.H,h.hh,M,h.hh,M,A.AA,DRID*XX

Field Number	Description
1	UTC of Position fix
2,3	Latitude in DDMM,MMMM, N (North) or S (South). [1]
4,5	Longitude in DDDMM,MMMM format, E(East) or W (West). [1]
6	GNSS Quality Indicator: 0=No GNSS, 1=GNSS, 2=DGNSS (VBS), 4=RTK fixed, 5=HP/XP/G2 or RTK float.
7	Number of Satellites in Use.
8	Horizontal Dilution of Precision (HDOP).
9,10	Height above Mean Sea level in Meters, M = Meters.
11,12	Geodial Separation in Meters, M = Meters. [2]
13	Age of Differential GNSS Data. [3]
14	Differential Reference Station ID (0000 – 1023) [4]

Table 5: Description of the GGA message.

NOTES:

1. The GGA message provides 8 decimal places. In non-differential mode, only the first four decimals are relevant. In (VBS) differential mode, the first five decimals are relevant. In HP/XP mode, the first seven decimals are relevant.
2. Geodial Separation is the difference between the WGS-84 earth ellipsoid and mean-sea-level (MSL).
3. Time in seconds since the last SeaSTAR correction update.
4. For SeaSTAR, the following reference station IDs are valid:
   0100 (VBS),
   1000 (HP, no orbits)
   1001 (HP, XP orbits)
   1002 (HP, G2 GPS orbits),
   1008 (XP-GPS)
   1009 (XP-GPS+GLONASS)
   1012 (G2-GPS)
   1013 (G2-GPS+GLONASS)
   1016 (HP/XP-GPS)
   1017 (HP/XP-GPS + GLONASS)
   1020 (HP/G2-GPS)
   1021 (HP/G2-GPS+GLONASS)

DTM – Datum reference

The DTM message contains the ID of the datum selected, along with configured offsets.

$GPDTM,ldID,dsdc,LatOfs,LatDir,LonOfs,LonDir,AltOfs,RDID*XX

Field Number	Description
1	Local datum ID
2	Datum subdivision code (null)
3	Latitude offset in decimal minutes
4	Direction of latitude offset, N (North) or S (South)
5	Longitude offset in decimal minutes
6	Direction of longitude offset, E (East) or W (West)
7	Altitude offset in meters
8	Reference Datum ID

Table 6: Description of the DTM message.

GBS – GNSS satellite fault detection

The GBS message reports the IDs of GNSS satellites that may be qualified as outliers based on receiver autonomous integrity (RAIM) checks.

$GNGBS,hhmmss.ss,elat,elon,eh,SVID,mdet,bias,noise*XX

Field Number	Description
1	UTC time
2	Expected error in latitude (m, 1-sigma), negative is South
3	Expected error in longitude (m, 1-sigma), negative is West
4	Expected error in height (m, 1-sigma)
5	ID number of most likely failed satellite
6	Probability of missed detection (0.0000 to 0.9500)
7	Estimate of bias for failed satellite (m, 1-sigma)
8	Estimate of noise for failed satellite (m, 1-sigma)

Table 7: Description of the GBS message.

GLL - Geographic Position – Latitude/Longitude

The GLL message contains the latitude and longitude of the present position, the time of the position fix and its status.

$GPGLL,ddmm.mmmmmmm,D,dddmm.mmmmmmm,D,hhmmss.ss,A*XX

Field Number	Description
1,2	Latitude, N (North) or S (South).
3,4	Longitude, E (East) or W (West).
5	UTC of Position.
6	Status: A = Valid, V = Invalid.

Table 8: Description of the GLL message.

GNS – GNSS time, position and positioning of GPS+GLONASS

The GNS message includes data on time, position and positioning of GPS+GLONASS.

$GNGNS,hhmmss.ss,ddmm.mmmmm,D,dddmm.mmmmm,D,GG,sv,H.H,h.hh,hh.hh,A.AA,DRID*XX

Field Number	Description
1	UTC of Position fix
2,3	Latitude in DDMM,MMMM, N (North) or S (South). [1]
4,5	Longitude in DDDMM,MMMM format, E(East) or W (West). [1]
6	GNSS mode indicator. The first character indicates GPS mode, the second character indicates GLONASS mode. Valid modes are: N=No fix Satellite system not used in the position solution or solution not valid A=Autonomous Satellite system used in non-differential mode in position fix D=Differential Satellite system used in differential mode in position fix P=PPS PPS independent positioning mode R=RTK RTK fix solution F=Float RTK float solution E=Estimated Estimated position mode M=Manual Manual input mode S=Simulator Simulator mode
7	Total number of satellites used for position computation.
8	Horizontal Dilution of Precision (HDOP).
9	Height above Mean Sea level in meters.
10	Geodial Separation, in meters
11	Age of Differential GNSS Data.
12	Differential Reference Station ID (0000 – 1023) [4]

Table 9: Description of the GNS message.

NOTES:

1. When the receiver is using only one satellite system (GPS or GLONASS), the corresponding GNS message is output. When the receiver is using both GPS and GLONASS, three consecutive GNS messages are output. The first one is a $GNGNS message containing all of the information fields except the age of differential data and reference station ID, which will be null fields. This message is followed by a GPGNS and a GLGNS message containing only the UTC time, number of satellites for the selected satellite system, age of differential data and reference station ID. All other fields in the GPGNS and GLGNS messages will be null.

GRS – GNSS Range Residuals

The GRS message is used to support the Receiver Autonomous Integrity Monitoring (RAIM).

$GPGRS,hhmmss.ss,R,r.r,r.r,r.r,r.r,r.r,r.r,r.r,r.r,r.r,r.r,r.r,r.r,r.r,r.r,*XX

Field Number	Description
1	UTC time of GGA position fix
2	Residuals 0: Residuals used to calculate position given in the matching GGA line 1: Residuals recomputed after the GGA position was computed
3 to 14	Range residuals for satellites used in the navigation solution, in meters

Table 10: Description of the GRS message.

NOTES:

1. When running in HP or XP mode this NMEA message is not valid.

GSA – GNSS DOP and Active Satellites

The GSA message indicates the GNSS receivers operating mode and lists the satellites used for navigation and the DOP values of the position solution.

$GPGSA,m,f,sv,sv,sv,sv,sv,sv,sv,sv,sv,sv,sv,sv,P.P,H.H,V.V*XX

Field Number	Description
1	Mode: M = Manual, A = Automatic.
2	Current Mode 1 = Fix not available, 2 = 2D fix, 3 = 3D fix.
3 to 14	PRN numbers of the satellites used in the position solution. *
15	Position Dilution of Precision (PDOP).
16	Horizontal Dilution of Precision (HDOP).
17	Vertical Dilution of Precision (VDOP)

Table 11: Description of the GSA message.

NOTE:
1. When less than 12 satellites are used, the unused fields are null.

GST – Position Error Statistics

The GST message is used to support Receiver Autonomous Integrity Monitoring (RAIM).

$GPGST,hhmmss.ss,S.S,M.M,m.m,ddd.d,y.y,x.x,h.h,*XX

Field Number	Description
1	UTC time of position fix
2	RMS value of the standard deviation of the range inputs to the navigation process (range inputs include pseudo ranges and DGNSS corrections)
3	Standard deviation of semi-major axis of error ellipse, in meters
4	Standard deviation of semi-minor axis of error ellipse, in meters
5	Orientation of semi-major axis of error ellipse, in degrees from true north
6	Standard deviation of latitude error, in meters
7	Standard deviation of longitude error, in meters
8	Standard deviation of altitude error, in meters

Table 12: Description of the GST message.

GSV – GNSS Satellites in View

The GSV message identifies the number of SVs in view, the PRN numbers, elevation, azimuth and SNR values.

$GPGSV,M,S,T,sv,el,azm,snr,sv,el,azm,snr,sv,el,azm,snr,sv,el,azm,snr*XX

Field Number	Description
1	Total number of sentences of this type in this cycle
2	Sentence number
3	Total number of SVs visible
4	SV PRN number
5	Elevation in degrees, 90° maximum
6	Azimuth, degrees from true north, 000° to 359°
7	SNR, 00-99 dB (null when not tracking)
8-11	Information about second SV, same format as fields 4-7
12-15	Information about third SV, same format as fields 4-7
16-19	Information about fourth SV, same format as fields 4-7

Table 13: Description of the GSV message.

HDT – Heading from True North

The HDT message shows the heading of the receiver, relative to True North

$GPHDT,hhh.hhh,T*XX

Field Number	Description
1	Heading in degrees
2	T: Indicates heading relative to True North

Table 14: Description of the HDT message.

PFUGDP – Proprietary Fugro positioning message

The PFUGDP message is a proprietary message containing information about the type of positioning system, position, number of satellites and position statistics.

$PFUGDP,GP,hhmmss.ss,ddmm.mmmmm,D,dddmm.mmmmm,D,sv,QI,DD,lt,ln,dir,ht*XX

Field Number	Description
1	Type of positioning system (GP = GPS, GL = GLONASS, GN = GNSS)
2	UTC of Position fix
3,4	Latitude in DDMM,MMMMM format, N (North) or S (South).
5,6	Longitude in DDDMM,MMMMM format, E (East) or W (West).
7	Number of satellites in use
8	DPVOA (UKOOA) Quality indicator (0-9) (see note 1)
9	DGNSS mode indicator (as defined for NMEA standard telegram $__GNS)
10	Error ellipse standard deviation semi-major axis, in meters
11	Error ellipse standard deviation semi-minor axis, in meters
12	Direction of the semi-major axis of the error ellipse, in degrees
13	RMS value of the standard deviation of the range inputs to the navigation process (see note 2)

Table 15: Description of the PFUGDP message.

Note 1: This quality indicator is defined in “Guidelines on the use of DGPS as a positioning reference in DP Control Systems” IMCA M141, dated Oct 1997.
See http://www.imca-int.com/publications/marine/imca.html

Note 2: This is the same as the definition in the GST telegram in the “NMEA 0183 Standard For Interfacing Marine Electronic Devices” from version 2.20, dated January 1, 1997. See http://www.nmea.org/0183.htm.

PTNL,AVR – Time, Yaw, Tilt, Range for Moving Baseline RTK

The PTNL,AVR message is a proprietary message containing time and attitude information (requires two receivers in vector mode)

$PTNL,AVR,hhmmss.s,yYYY.YYYY,Yaw,tT.TTTT,Tilt,,,rr.rrr,Q,PDOP,sv*XX

Field Number	Description
1	UTC time of the vector fix in hhmmss.s format
2	Yaw angle in degrees
3	Yaw
4	Tilt angle in degrees
5	Tilt
6	Reserved
7	Reserved
8	Range in meters
9	GNSS quality indicator: 0: Fix not available or invalid 1: Autonomous GNSS fix 2: Differential carrier phase solution RTK (Float) 3: Differential carrier phase solution RTK (Fix) 4: Differential code-based solution, DGNSS
10	PDOP
11	Number of satellites used in solution

Table 16: Description of the PTNLEV message.

PTNL,BPQ – Base station position and quality indicator

The PTNL,BPQ message is a proprietary message describing the base station position and its quality. It is used when the moving base antenna position and quality are required on one serial port (along with a heading message) from a receiver in heading mode.

$PTNL.BPQ,hhmmss.ss,ddmmyy,llll.lllllll,D,lllll.lllllll,D,EHThh.hhh,M,Q*XX

Field Number	Description
1	UTC time of position fix in hhmmss.ss format
2	UTC date of position fix in ddmmyy format
3	Latitude in ddmm.mmmmmmm format
4	Direction of Latitude, N (North) or S (South)
5	Longitude in dddmm.mmmmmmm format
6	Direction of Longitude, E (East) or W (West)
7	Ellipsoidal height of fix (antenna height above ellipsoid). Must start with EHT.
8	M indicates height is measured in meters
9	GNSS quality indicator: 0: Fix not available or invalid 1: Autonomous GNSS fix 2: DGNSS or SeaSTAR VBS fix 4: RTK Fixed 5: SeaSTAR HP, XP or G2 or float RTK

Table 17: Description of the PTNLID message.

PTNLDG – Proprietary DGNSS Receiver Status message

The PTNLDG message is a proprietary message for identifying the DGNSS receiver channel strength, channel SNR, channel frequency, channel bit rate, channel number, channel tracking status, RTCM source and channel performance indicator for satellite DGNSS.

$PTNLDG,SS.S,s.s,fffffff.f,bbbb,ch,ts,R,PI,,,*XX

Field Number	Description
1	Channel signal strength, in 1 dBμV/m. For satellite, this is the ADC input voltage level.
2	Channel signal to noise (SNR) level, in dB
3	Channel frequency, in kHz.
4	Channel bit rate, in bits per second (bps)
5	Channel number (0-99)
6	Channel tracking status 0: Channel idle 1: Wideband FFT search 2: Searching for signal 3: Channel has acquired signal 4: Channel has locked on signal 5: Channel disabled
7	Specified channel is used as RTCM source 0: Not used 1: Used
8	Channel tracking performance indicator. For satellite, this is the time since last sync, in tenths of seconds ranging from 0-255.

Table 18: Description of the PTNLDG message.

NOTES:
1. The PTNLDG message fields are defined in free format.
2. Leading zeroes in a field are omitted (for example, channel bitrate 25 bps is displayed as xxx,**25**,xxx instead of xxx,**00025**,xxx).
3. If a channel is disabled, the channel fields can be null fields (showing commas only). If more than one channel is available, the message should be repeated for each channel.

PTNL,GGK – Time, Position, Position Type, DOP

The PTNL,GGK message is a proprietary message containing time, position, position type and DOP.

$PTNL,GGK,hhmmss.ss,ddmmyy,ddmm.mmmmmm,D,dddmm.mmmmmm,D,
Q,sv,P.P,EHTh.hhh,M*XX

Field Number	Description
1	UTC of position fix, in hhmmss.ss format
2	UTC Date of position in ddmmyy format
3	Latitude in ddmm.mmmmmmm format
4	Direction of latitude (N: North, S: South)
5	Longitude in dddmm.mmmmmmm format
6	Direction of longitude (E: East, W: West)
7	GNSS quality indicator 0: fix not available or invalid 1: Autonomous GNSS fix 2: RTK float solution 3: RTK fix solution 4: Differential, code phase only (DGNSS) solution 5: SBAS solution – WAAS, EGNOS, MSAS 6: RTK float or RTK location 3D network solution 7: RTK fixed 3D network solution 8: RTK float or RTK location 2D network solution 9: RTK fixed 2D network solution 10: SeaSTAR HP/XP/G2 solution 11: SeaSTAR VBS solution 12: Location RTK solution 13: Beacon DGNSS
8	Number of satellites used in GNSS solution
9	DOP of fix
10	Ellipsoidal height of fix (antenna height above ellipsoid). Must start with EHT
11	M: Ellipsoidal height is measured in meters

Table 19: Description of the PTNL,GGK message.

PTNL,PJK – Local Coordinate Position Output

The PTNL,PJK message is a proprietary message containing time, date, and position in ENU format.

$PTNL,PJK,hhmmss.ss,ddmmyy,nnnnnn.nnn,N,eeeeeee.eee,E,Q,sv,DOP,EHTh.hhh,M*XX

Field Number	Description
1	UTC of position fix, in hhmmss.ss format
2	UTC Date of position in ddmmyy format
3	Northing, in meters
4	Direction of Northing will always be N (North)
5	Easting, in meters
6	Direction of Easting will always be E (East)
7	GNSS quality indicator 0: fix not available or invalid 1: Autonomous GNSS fix 2: RTK float solution 3: RTK fix solution 4: Differential, code phase only (DGNSS) solution 5: SBAS solution – WAAS, EGNOS, MSAS 6: RTK float 3D network solution 7: RTK fixed 3D network solution 8: RTK float 2D network solution 9: RTK fixed 2D network solution 10: SeaSTAR HP/XP/G2 solution 11: SeaSTAR VBS solution 12: Location RTK solution 13: Beacon DGNSS
8	Number of satellites used in GNSS solution
9	DOP of fix
10	Ellipsoidal height of fix (antenna height above ellipsoid). Must start with EHT
11	M: Ellipsoidal height is measured in meters

Table 20: Description of the PTNL,PJK message.

PTNL,PJT – Projection Type

The PTNL,PJT message contains information about the receiver's datum projection used.

$PTNL,PJT,CCCCC,PPPPPP,*XX

Field Number	Description
1	Coordinate system name (can include multiple words)
2	Projection name (can include multiple coordinates)

Table 21: Description of the PTNL,PJT message.

PTNL,VGK – Vector Information

The PTNL,VGK message is a proprietary message containing time, date, and vector information (ENU).

$PTNL,VGK,hhmmss.ss,ddmmyy,eeee.eee,nnnnn.nnn,uuuu.uuu,Q,sv,DOP,M*XX

Field Number	Description
1	UTC of vector, in hhmmss.ss format
2	Date in ddmmyy format
3	East component of vector, in meters
4	North component of vector, in meters
5	Up component of vector, in meters
6	GNSS quality indicator 0: fix not available or invalid 1: Autonomous GNSS fix 2: RTK float solution 3: RTK fix solution 4: Differential, code phase only (DGNSS) solution 5: SBAS solution – WAAS, EGNOS, MSAS 6: RTK float 3D network solution 7: RTK fixed 3D network solution 8: RTK float 2D network solution 9: RTK fixed 2D network solution 10: SeaSTAR HP/XP/G2 solution 11: SeaSTAR VBS solution 12: Location RTK solution 13: Beacon DGNSS
7	Number of satellites used in vector solution
8	DOP of fix
9	M: Vector components are in meters

Table 22: Description of the PTNL,VGK message.

PTNL,VHD – Heading Information

The PTNL,VHD message is a proprietary message containing information about azimuth, vertical angle and range and their time derivatives.

$PTNL,VHD,hhmmss.ss,ddmmyy,AAA.AAA,aa.aaa,VV.VVV,v.vvv,R.RRR,r.rrr,Q,sv,DOP*XX

Field Number	Description
1	UTC of vector, in hhmmss.ss format
2	Date in ddmmyy format
3	Azimuth
4	ΔAzimuth/ΔTime
5	Vertical Angle
6	ΔVertical Angle/ΔTime
7	Range
8	ΔRange/ΔTime
9	GNSS quality indicator 0: fix not available or invalid 1: Autonomous GNSS fix 2: RTK float solution 3: RTK fix solution 4: Differential, code phase only (DGNSS) solution 5: SBAS solution – WAAS, EGNOS, MSAS 6: RTK float 3D network solution 7: RTK fixed 3D network solution 8: RTK float 2D network solution 9: RTK fixed 2D network solution 10: SeaSTAR HP/XP/G2 solution 11: SeaSTAR VBS solution 12: Location RTK solution 13: Beacon DGNSS
10	Number of satellites used in solution
11	PDOP

Table 23: Description of the PTNL,VHD message.

RMC – Recommended Minimum Specific GNSS Data

The RMC message identifies the UTC time, status, latitude, longitude, speed over ground (SOG), date and magnetic variation of the position fix.

$GPRMC,hhmmss.ss,A,ddmm.mmmmm,D,dddmm.mmmmm,D,sss.ss,T.T,DDMMYY,mm.m,D,M*XX

Field Number	Description
1	UTC time of the position fix in hhmmss.ss format
2	Status A: Active V: Void
3	Latitude
4	Latitude direction: N = North, S = South
5	Longitude
6	Longitude direction: W = West, E = East
7	Speed Over Ground (SOG) in knots
8	Track Made Good, True, in degrees
9	Date in ddmmyy format
10	Magnetic Variation in degrees
11	Direction of magnetic variation E: Easterly variation from True course (subtracts from True course) W: Westerly variation from True course (adds to True course)
12	Mode Indication A: Autonomous D: Differential F: Float RTK N: Data not valid R: Fix RTK

Table 24: Description of the RMC message.

ROT – Rate and Direction of Turn

The ROT message contains the rate and direction of turn of the receiver.

$GPROT,dd.d,A*XX

Field Number	Description
1	Rate of turn, degrees/minutes, '-' indicates bow turns to port
2	A: Active (valid data) V: Void (invalid data)

Table 25: Description of the ROT message.

VTG – Course Over Ground and Ground Speed

The VTG (Velocity True Ground) message identifies the actual track made good and speed over ground.

$GPVTG,t,T,m,M,n.nn,N,k.kk,K*XX

Field Number	Description
1	Track made good (degrees true)
2	Fixed text 'T' shows that track made good is relative to true north
3	Track made good (degrees magnetic)
4	Fixed text 'M' shows that track made good is relative to magnetic north
5	Speed over ground in knots
6	Fixed text 'N' shows that speed over ground is in knots
7	Speed over ground in kilometers/hour
8	Fixed text 'K' shows that speed over ground is in kilometers/hour

Table 26: Description of the VTG message.

ZDA – Time and Date

The ZDA message contains UTC, the day, the month and the year of the local time zone.

$GPZDA,hhmmss.ss,DD,MM,YYYY,lh,lm

Field Number	Description
1	UTC time in hhmmss.ss format.
2	Day (01 – 31).
3	Month (01 – 12).
4	Year.
5	Local time zone offset from GMT (00 to ± 13 Hours). [1]
6	Local time zone offset from GMT (00 to 59 minutes).

Table 27: Description of the ZDA message.

NOTES:
1. Local time zone offset is the number of whole hours added to local time to obtain UTC. The zone offset is always negative for eastern longitudes.
2. Fields 5 and 6 together yield the total offset from GMT.

1PPS – ASCII time tag

The time tag is output about 0.5 seconds before the corresponding 1PPS pulse. Time tags are output in ASCII format on a user-selected output port. The 1PPS time tag can be output in combination with NMEA messages over the same output port. The format of the 1PPS time tag does not follow the 'standard' NMEA format of comma-separated fields.

Output of the 1PPS time message can be enabled or disabled using the I/O menu from the receivers' web interface.

UTC yy.mm.dd hh:mm:ss ab

Field Number	Description
1	Year, month and date of the output pulse
2	UTC time of the output pulse in 24-hour format
3	a is an integer number representing the position fix type: 1: time only 2: 1D & time 3: currently unused 4: 2D & time 5: 3D & time b is the number of GNSS satellites being tracked.

Table 28: Description of the ZDA message.

NOTE:
If the receiver is not tracking satellites, the time tag is based on the receiver clock. In this case, both a and b are represented by "??". The time readings from the receiver clock are less accurate than time readings determined from the satellite signals.

Appendix C

GSOF Message Options

The SeaSTAR 9200-G2 may output a number of GSOF (binary format) messages. Which messages are output over which port can be selected using either the receiver's front panel interface (see "Mode Settings"on page 13) or the receiver's web interface (see "I/O Configuration" on page 35). The default (pre-selected) value for the output rate is 1 Hz, but 2, 5 and 10 Hz or a number of values lower than 1 Hz may also be selected.

Message	Function
TIME	Position time
LLH	Latitude, Longitude, Height
ECEF	Earth-Centered, Earth-Fixed position
ECEF DELTA	Earth-Centered, Earth-Fixed Delta position
NEU DELTA	Tangent Plane Delta
Velocity	Velocity data
PDOP	PDOP Info
SIGMA	Position Sigma info
SV Brief	SV Brief info
SV Detail	SV Detailed info
UTC	Current UTC time
BATT/MEM	Receiver battery and memory status
ATTITUDE	Attitude info
Base Position and Quality Indicator	Base station position and its quality
L-band status info	L-band satellite status and HP/VBS engine information

Table 29: GSOF messages available for the 9200-G2

General GSOF message output format

Byte	Item	Type	Value	Meaning
0	STX	CHAR	02h	Start transmission
1	STATUS	CHAR	See Table 31	Receiver status code
2	PACKET TYPE	CHAR	40h	Report Packet 40h (GENOUT)
3	LENGTH	CHAR	00h-FAh	Data byte count
4	TRANSMISSION NUMBER	CHAR		Unique number assigned to a group of record packet pages. Prevents page mis-matches when multiple sets of record packets exist in output stream.
5	PAGE INDEX	CHAR	00h-FFh	Index of current packet page
6	MAX PAGE INDEX	CHAR	00h-FFh	Maximum index of last packet in one group of records
			One or more GSOF messages	
	Output record type	CHAR	01h	For example, TIME (Type 1 Record)
	Record length	CHAR	0Ah	Bytes in record
			Various fields depending on output record type	
	There can be multiple records in one GENOUT packet. There could be multiple GENOUT packets per epoch. Records may be split over two consecutive packets.			
L+4	Checksum	-	-	(Status + type + length + data bytes) modulo 256
L+5	ETX (03h)	-	-	End transmission

Table 30: Report packet 40h structure (GENOUT)

Each message begins with a 4-byte header, followed by the bytes of data in each packet. The packet ends with a 2-byte trailer. Byte 3 is set to 0 (00h) when the packet contains no data. Most data is transmitted between the receiver and remote device in binary format.

Byte number	Message	Description
Bit 0	1	Reserved
Bit 1	1	Low Battery
Bit 2-7	0-63	Reserved

Table 31: Receiver status codes

Reading binary values

The receivers store numbers in Motorola format. The byte order of these numbers is the opposite of what personal computers (PCs) expect (Intel format). To supply or interpret binary numbers (8-byte DOUBLES, 4-byte LONGS, and 2-byte INTEGERS), the byte order of these values must be reversed. This section contains a detailed description of the Motorola format.

INTEGER data types

The INTEGER data types (CHAR, SHORT, and LONG) can be signed or unsigned. By default, they are unsigned. All integer data types use two's complement representation. The following table lists the integer data types.

Type	# of bits	Range of values (signed)	(unsigned)
CHAR	8	-128 to 127	0 to 255
SHORT	16	-32768 to 32767	0 to 65535
LONG	32	-2147483648 to 2147483647	0 to 4294967295

Table 32: Integer data types

FLOATING-POINT data types

Floating-point data types are stored in the IEEE SINGLE and DOUBLE precision formats. Both formats have a sign bit field, an exponent field, and a fraction field. The fields represent floating-point numbers in the following manner:

Floating-Point Number = <sign> 1.<fraction field> x $2^{(<\text{exponent field}> - \text{bias})}$

Sign bit field
The sign bit field is the most significant bit of the floating-point number. The sign bit is 0 for positive numbers and 1 for negative numbers.
Fraction field
The fraction field contains the fractional part of a normalized number. Normalized numbers are greater than or equal to 1 and less than 2. Since all normalized numbers are of the form 1.XXXXXXXX, the 1 becomes implicit and is not stored in memory. The bits in the fraction field are the bits to the right of the binary point, and they represent negative powers of 2.
For example:
0.011 (binary) = $2^{-2} + 2^{-3} = 0.25 + 0.125 = 0.375$
Exponent field
The exponent field contains a biased exponent; that is, a constant bias is subtracted from the number in the exponent field to yield the actual exponent. (The bias makes negative exponents possible.) If both the exponent field and the fraction field are zero, the floating-point number is zero.
NaN
A NaN (Not a Number) is a special value which is used when the result of an operation is undefined. For example, adding positive infinity to negative infinity results in a NaN.

FLOAT data type

The FLOAT data type is stored in the IEEE single-precision format which is 32 bits long. The most significant bit is the sign bit, the next 8 most significant bits are the exponent field, and the remaining 23 bits are the fraction field. The bias of the exponent is 127. The range of single-precision format values is from 1.18 x 10^{-38} to 3.4 x 10^{38}. The floating-point number is precise to 6 decimal digits.

31	30 23	22 0
S	Exp. + Bias	Fraction

0 000 0000 0 000 0000 0000 0000 0000 0000 = 0.0
0 011 1111 1 000 0000 0000 0000 0000 0000 = 1.0
1 011 1111 1 011 0000 0000 0000 0000 0000 = -1.375
1 111 1111 1 111 1111 1111 1111 1111 1111 = NaN

DOUBLE data type

The DOUBLE data type is stored in the IEEE double-precision format which is 64 bits long. The most significant bit is the sign bit, the next 11 most significant bits are the exponent field, and the remaining 52 bits are the fractional field. The bias of the exponent is 1023. The range of single precision format values is from 2.23×10^{-308} to 1.8×10^{308}. The floating-point number is precise to 15 decimal digits.

63	62 52	51 0
S	Exp. + Bias	Fraction

0 000 0000 0000 0000 0000 ... 0000 0000 0000 = 0.0
0 011 1111 1111 0000 0000 ... 0000 0000 0000 = 1.0
1 011 1111 1110 0110 0000 ... 0000 0000 0000 = -0.6875
1 111 1111 1111 1111 1111 ... 1111 1111 1111 = NaN

GSOF message definitions

When GSOF output is enabled, the following messages can be generated.

TIME

This message describes position time information. It contains the GPS time (in milliseconds of GPS week), GPS week number, Number of satellites used and an Initialization counter.

Field	Item	Type	Value	Meaning
0	Output record type	Char	01h	Position time output record
1	Record length	Char	0Ah	Bytes in record
2-5	GPS time (ms)	Long	msecs	GPS time, in milliseconds of GPS week
6-7	GPS week number	Short	number	GPS week count since January 1980
8	Number of SVs used	Char	00h-0Ch	Number of satellites used to determine the position (0-12)
9	Position flags 1	Char	See Table 48	Reports first set of position attribute flag values
10	Position flags 2	Char	See Table 49	Reports second set of position attribute flag values
11	Initialized number	Char	00h-FFh	Increments with each initialization (modulo 256)

Table 33: Time (type 1 record)

LLH

This message describes latitude, longitude and height. It contains the WGS-84 latitude and longitude (in radians) and the WGS-84 height (in meters).

Field	Item	Type	Value	Meaning
0	Output record type	Char	02h	Latitude, Longitude and height output record
1	Record length	Char	18h	Bytes in record
2-9	Latitude	Double	Radians	Latitude from WGS-84 datum
10-17	Longitude	Double	Radians	Longitude from WGS-84 datum
18-25	Height	Double	Meters	Height from WGS-84 datum

Table 34: Latitude, Longitude and Height (type 2 record)

ECEF

This message describes the ECEF position. It contains the Earth-Centered, Earth-Fixed X, Y, Z coordinates in meters.

Field	Item	Type	Value	Meaning
0	Output record type	Char	03h	Earth-Centered, Earth-Fixed position output record
1	Record length	Char	18h	Bytes in record
2-9	X	Double	Meters	WGS-84 ECEF X-axis coordinate
10-17	Y	Double	Meters	WGS-84 ECEF Y-axis coordinate
18-25	Z	Double	Meters	WGS-84 ECEF Z-axis coordinate

Table 35: ECEF Position (type 3 record)

ECEF Delta

This message describes the ECEF Delta position. It contains the Earth-Centered, Earth-Fixed X, Y, Z deltas between the rover and base position in meters.

Field	Item	Type	Value	Meaning
0	Output record type	Char	06h	Earth-Centered, Earth-Fixed (ECEF) delta output record
1	Record length	Char	18h	Bytes in record
2-9	Delta X	Double	Meters	ECEF X-axis delta between rover and base station positions
10-17	Delta Y	Double	Meters	ECEF Y-axis delta between rover and base station positions
18-25	Delta Z	Double	Meters	ECEF Z-axis delta between rover and base station positions

Table 36: ECEF Delta (type 6 record)

NEU Delta

This message contains Tangent Plane Delta information. It contains the North, East and Up deltas of the vecotr from the base to the rover (in meters) projected onto a plane tangent to the WGS-84 ellipsoid at the base receiver.

Note: These records are only output if a valid DGNSS solution is computed.

Field	Item	Type	Value	Meaning
0	Output record type	Char	07h	Tangent plane delta output record
1	Record length	Char	18h	Bytes in record
2-9	Delta east	Double	Meters	East component of vector from base station to rover, projected on a plane tangent to the WGS-84 ellipsoid at the base station
10-17	Delta north	Double	Meters	North component of tangent plane vector
18-25	Delta up	Double	Meters	Difference between ellipsoidal height of tangent plane at base station and a parallel plane passing through rover point

Table 37: NEU Delta (type 7 record)

Velocity

This message provides velocity information. It contains the horizontal and vertical velocity in meters per second and the heading in radians, referenced to WGS-84 True North.

Field	Item	Type	Value	Meaning
0	Output record type	Char	08h	Velocity data output record
1	Record length	Char	0Dh	Bytes in record
2	Velocity flags	Char	See Table 51	Velocity status flags
3-6	Speed	Float	m/s	Horizontal speed
7-10	Heading	Float	Radians	True north heading in the WGS-84 datum
11-14	Vertical velocity	Float	m/s	Vertical velocity

Table 38: Velocity (type 8 record)

PDOP

This message describes the PDOP information. It contains PDOP, HDOP, VDOP and TDOP data.

Field	Item	Type	Value	Meaning
0	Output record type	Char	09h	PDOP information output record
1	Record length	Char	10h	Bytes in record
2-5	PDOP	Float		Position Dilution of Precision
6-9	HDOP	Float		Horizontal Dilution of Precision
10-13	VDOP	Float		Vertical Dilution of Precision
14-17	TDOP	Float		Time Dilution of Precision

Table 39: PDOP (type 9 record)

SIGMA

This message describes the Position Sigma information. It contains the position RMS, sigma East, North and Up in meters, covariance east-north, the semi-major and semi-minor axes of the error ellipse in meters, the orientation of the semi-major axis in degrees from True North, the unit variance and the number of epochs.

Field	Item	Type	Value	Meaning
0	Output record type	Char	0Ch	Position sigma infor-mation output record
1	Record length	Char	26h	Bytes in record
2-5	Position RMS	Float		Root means square of position error calcu-lated for overdeter-mined positions
6-9	Sigma east	Float	Meters	
10-13	Sigma north	Float	Meters	
14-17	Covar. east-north	Float	number	Covariance east-north (dimensionless)
18-21	Sigma up	Float	Meters	
22-25	Semi-major axis	Float	Meters	Semi-major axis of error ellipse
26-29	Semi-minor axis	Float	Meters	Semi-minor axis of error ellipse
30-33	Orientation	Float	degrees	Orientation of semi-major axis, clockwise from True North.
34-37	Unit variance	Float		Valid only for over-determined solutions. Unit variance should approach 1.0 value. A value of less than 1.0 indicates that apriori variances are too pessimistic.
38-39	Number of epochs	Short	count	Number of measure-ment epochs used to compute the position. Could be greater than 1 for positions subjected to static constraint. Always 1 for kinematic.

Table 40: SIGMA (type 12 record)

SV Brief

This message provides brief satellite information. It contains the number of satellites tracked, the PRN number of each satellite and flags indicating the satellite status.

Field	Item	Type	Value	Meaning
0	Output record type	Char	0Dh	Brief satellite infor-mation output record
1	Record length	Char		Bytes in record
2	Number of SVs	Char	00h-18h	Number of satellites included in record. Includes all tracked satellites, all satellites used in the position solution and all satellites in view.
	The following bytes are repeated for number of SVs			
	PRN	Char	01h-20h	Pseudorandom number of satellites (1-32)
	SV Flags1	Char	See Table 52	First set of satellite status bits
	SV Flags2	Char	See Table 53	Second set of satellite status bits

Table 41: SV Brief (type 13 record)

SV Detail

This message provides detailed satellite information. It contains the number of satellites tracked, the PRN number of each satellite, flags indicating the satellite status, the elevation above the horizon in degrees, the Azimuth from True North and the Signal-to-noise ratios (SNR) on both L1 and L2.

Field	Item	Type	Value	Meaning
0	Output record type	Char	0Eh	Detaled satellite infor-mation output record
1	Record length	Char	1 + 8x (number of SVs)	Bytes in record
2-9	Number of SVs	Char	00h-18h	Number of satellites included in record. Includes all tracked satellites, all satellites used in the position solution and all satellites in view.
	The following bytes are repeated for number of SVs			
	PRN	Char	01h-20h	Pseudorandom number of satellites (1-32)
	Flags1	Char	See Table 52	First set of satellite status bits
	Flags2	Char	See Table 53	Second set of satellite status bits
	Elevation	Char	Degrees	Angle of satellite above the horizon
	Azimuth	Short	Degrees	Azimuth of satellite from True North
	SNR L1	Char	dB * 4	Signal-to-noise ratio of L1 signal, multiplied by 4. Zero for satellites currently not tracked on L1.
	SNR L2	Char	dB * 4	Signal-to-noise ratio of L2 signal, multiplied by 4. Zero for satellites currently not tracked on L2.

Table 42: SV Detail (type 14 record)

UTC

This message describes current time information. It contains the GPS time (in milliseconds of GPS week), the GPS week number and the GPS to UTC time offset (in seconds).

Field	Item	Type	Value	Meaning
0	Output record type	Char	10h	UTC time information output record
1	Record length	Char	09h	Bytes in record
2-5	GPS millisecond of week	Long	msecs	Time when packet is sent from the receiver, in GPS milliseconds of week
6-7	GPS week number	Short	number	Week number since start of GPS time
8-9	UTC offset	Short	seconds	GPS to UTC time offset
10	Flags	Char	See Table 50	Flag bits indicating validity of Time and UTC offsets

Table 43: UTC (type 16 record)

Batt/Mem

This message provides information relating to the receiver battery (remaining battery power) and memory (remaining free memory).

Field	Item	Type	Value	Meaning
0	Output record type	Char	25h	Batt/Mem information output record
1	Record length	Char	0Ah	Bytes in record
2-3	Battery capacity	Unsigned short	%	Remaining battery capacity in % of full power
4-11	Remaining memory	Double	hours	Estimated remaining data logging time in hours

Table 44: Batt/Mem (type 37 record)

Attitude

This message provides attitude information relating to the vector between the Heading antenna and the Moving Base antenna. It contains the Tilt or vertical angle (in radians) from the Heading antenna to the Moving Base antenna relative to a horizontal plane through the heading antenna, the Heading or yaw (in radians) relative to True North and the Range or slope distance between the Heading antenna and the Moving Base antenna.

Field	Item	Type	Value	Meaning
0	Output record type	Char	1Bh	Attitude information
1	Record length	Char	2Ah	Bytes in record
2-5	GPS time	Long	msecs	GPS time in milli-seconds of GPS week
6	Flags	Char	See Table 54	Flag bits indicating validity of attitude components
7	Number of SVs used	Char	00h-0Ch	Number of satellites used to calculate attitude
8	Calculation mode	Char	See Table 55	Positioning mode
9	Reserved			Reserved
10-17	Tilt	Double	Radians	Tilt relative to horizontal plane
18-25	Yaw	Double	Radians	Rotation about the vertical axis relative to True North
26-33	Reserved			Reserved
34-41	Range	Double	Meters	Distance between antennas
42-43	PDOP	Short	0.1	Position Dilution of Precision

Table 45: Attitude (type 27 record)

Base Position and Quality indicator

This message describes the base station position and its quality. It is used when the moving base antenna position and quality are required on one serial port (along with a heading message) from a second 9200-G2 receiver in heading mode.

Field	Item	Type	Value	Meaning
0	Output record type	Char	29h	Base position and quality output record
1	Record length	Char	0Ah	Bytes in record
2-5	GPS time	Long	msecs	GPS time in milli-seconds of GPS week
6-7	GPS week number	Short	number	GPS week count since January 1980
8	Latitude	Double	Radians	The WGS-84 latitude, in radians, of the moving base antenna
9	Longitude	Double	Radians	The WGS-84 longitude, in radians, of the moving base antenna
10	Height	Double	Meters	The WGS-84 height, in meters, of the moving base antenna
11	Quality indicator	Char	00h-05h	The quality of the base station position: 0: Fix not available or invalid 1: Autonomous GPS 2: Differential SBAS or SeaSTAR VBS 4: RTK Fixed 5: SeaSTAR G2/XP/HP, location RTK or float RTK

Table 46: Base position and quality indicator (type 41 record)

Lband status info

This message provides information about the L-band satellite and the state of the SeaSTAR library modes

Field	Item	Type	Value	Meaning
0	Output record type	Char	28h	Lband status info
1	Record length	Char	46h	Bytes in record
2-6	Satellite name	Char		5-Character name of the L-band satellite the receiver is trying to track
7-10	Satellite frequency	Float	MHz	Nominal/requested satellite frequency in MHz.
11-12	Satellite bitrate	Unsigned short	Hz	Bitrate of the selected L-band satellite in Hz.
13-16	SNR	Float	dBHz	L-band SNR (C/No) value in dBHz.
17	HP/XP subscribed engine	Char	00h-04h	Subscribed engine in the HP/XP library: 0: XP 1: HP 2: G2 3: HP+G2 4: HP+XP 0xFF: Unknown
18	HP/XP lib. mode	Char	00h-01h	HP/XP Library mode: 0: Not active 1: Active
19	VBS lib. mode	Char	00h-01h	VBS Library mode: 0: Not active 1: Active
20	Beam mode	Char	00h-07h	Shows the mode of the L-band beam: 0: Off 1: FFT init 2: FFT running 3: Search init 4: Search running 5: Track init 6: Track searching 7: Tracking
21	SeaSTAR motion	Char	00h-02h	Shows the motion state reported by SeaSTAR library: 0: Dynamic 1: Static 2: SeaSTAR is not ready 0xFF: Unknown
22-25	3-σ hor.	Float	Meters	3-sigma horizontal precision threshold
26-29	3-σ vert.	Float	Meters	3-sigma vertical precision threshold
30	NMEA encryption	Char	00h-01h	NMEA encryption state: 0: Off 1: On
31-34	I/Q ratio	Float		(mean power in I)/(mean power in Q)
35-38	est. BER	Float		Estimated bit error rate
39-42	Unique words	Long		Total unique words (since the last search) = total messages
43-46	>1 bit error	Long		Total unique words with 1 or more bit errors (since the last search)
47-50	Bad bits	Long		Total bad unique word bits (since the last search)
51-54	Viterbi	Long		Total # of Viterbi symbols (since the last search). Resets to 0 when it gets over 0xFFFFFF00
55-58	Corr. Viterbi	Long		# of corrected Viterbi symbols (since the last search). Gets reset along with “total # of Viterbi symbols”

59-62	Bad msg	Long		# of bad messages (since the last search). Gets reset along with “total # of Viterbi symbols”
63	Frequency valid flag	Char	00h-01h	If 1, then ‘Meas. Frequency’ is accurate. If 0, then ‘Meas. Frequency’ could be off by quite a bit
64-71	Meas. Frequency	Double	Hz.	Measured satellite frequency in Hz. See also the ‘Frequency valid flag’.

Table 47: L-band status info (type 40 record)

Flags

Bit	Meaning
0	New position 0: No. 1: Yes
1	Clock fix calculated for current position 0: No. 1: Yes
2	Horizontal coordinates calculated for this position 0: No. 1: Yes
3	Height calculated for this position 0: No. 1: Yes
4	Weighted position 0: No. 1: Yes
5	Overdetermined position 0: No. 1: Yes
6	Ionosphere-free position 0: No. 1: Yes
7	Position uses filtered L1 pseudoranges 0: No. 1: Yes

Table 48: Position flags 1: bit values

Bit	Meaning
0	Differential position 0: Differential position is an autonomous or a WAAS solution 1: Position is a differential solution
1	Differential position method 0: Code 1: Phase including RTK, SeaSTAR HP, XP or G2
2	Differential position method 0: Code (DGNSS) or a float position (RTK). Uncorrected position is Autonomous (if bit 0 = 0) 1: Position is fixed integer phase position (RTK) Uncorrected position is WAAS (if bit 0 = 0)
3	SeaSTAR solution 0: Not active 1: SeaSTAR differential solution (HP, XP, G2 or VBS)
4	Position determined with static as a constraint 0: No. 1: Yes
5	Position is network RTK solution 0: No. 1: Yes
6	Position is Location RTK 0: No. 1: Yes
7	Position is Beacon DGNSS 0: No. 1: Yes

Table 49: Position flags 2: bit values

Bit	Meaning
0	Time information (week and millisecond of week) validity 0: Not valid 1: Valid
1	UTC offset validity 0: Not valid 1: Valid

Table 50: Flags: bit values

Bit	Meaning
0	Velocity data validity 0: Not valid 1: Valid
1	Velocity computation 0: Computed from doppler 1: Computed from consecutive measurements
2-7	Reserved (set to zero)

Table 51: Velocity flags: bit values

Bit	Meaning
0	Satellite Above Horizon 0: No. 1: Yes
1	Satellite Currently Assigned to a Channel (trying to track) 0: No. 1: Yes
2	Satellite Currently Tracked on L1 Frequency 0: No. 1: Yes
3	Satellite Currently Tracked on L2 Frequency 0: No. 1: Yes
4	Satellite Reported at Base on L1 Frequency 0: No. 1: Yes
5	Satellite Reported at Base on L2 Frequency 0: No. 1: Yes
6	Satellite Used in Position 0: No. 1: Yes
7	Satellite Used in Current RTK Process (Search, Propagate, Fix Solution) 0: No. 1: Yes

Table 52: SV flags 1: bit values

Bit	Meaning
0	Satellite Tracking P-Code on L1 Band 0: No. 1: Yes
1	Satellite Tracking P-Code on L2 Band 0: No. 1: Yes
2-7	Reserved (set to zero)

Table 53: SV flags 2: bit values

Bit	Meaning
0	Calibrated 0: No. 1: Yes
1	Tilt Valid 0: No. 1: Yes
2	Yaw Valid 0: No. 1: Yes
3	Reserved
4	Range Valid 0: No. 1: Yes
5-7	Reserved

Table 54: Attitude flags

Bit	Meaning
0-7	0: No position 1: Autonomous position 2: RTK/Float position 3: RTK/Fix position 4: DGNSS position

Table 55: Attitude calculation mode

Appendix D

Receiver Bluetooth connectivity

The 9200-G2 receiver comes with a built-in Bluetooth radio, which may connect up to three different Bluetooth devices simultaneously. The Bluetooth connections can be used as 'regular' COM ports to output data to Bluetooth enabled data collectors or as network (TCP/IP) ports, which can be used instead of a wired network to connect the 9200-G2 receiver to a computer. Mind, however, that initial configuration of the Bluetooth connections has to be done using the receivers' web interface, so a functioning wired network (or direct link TCP/IP cross cable) is still necessary for setting up your Bluetooth connections.

Pairing a Bluetooth device

Before the Bluetooth connection can be used, it has to be set up first by pairing the 9200-G2 receiver with another Bluetooth device. To do this, go to the "Bluetooth Inquiry and Remote Connection" menu screen (see Figure 39 on page 38) and click the "Perform New Inquiry" button. After a few moments, the receiver will show a list of all (with a default but configurable maximum of 5) discoverable Bluetooth devices within range (see Figure 66).

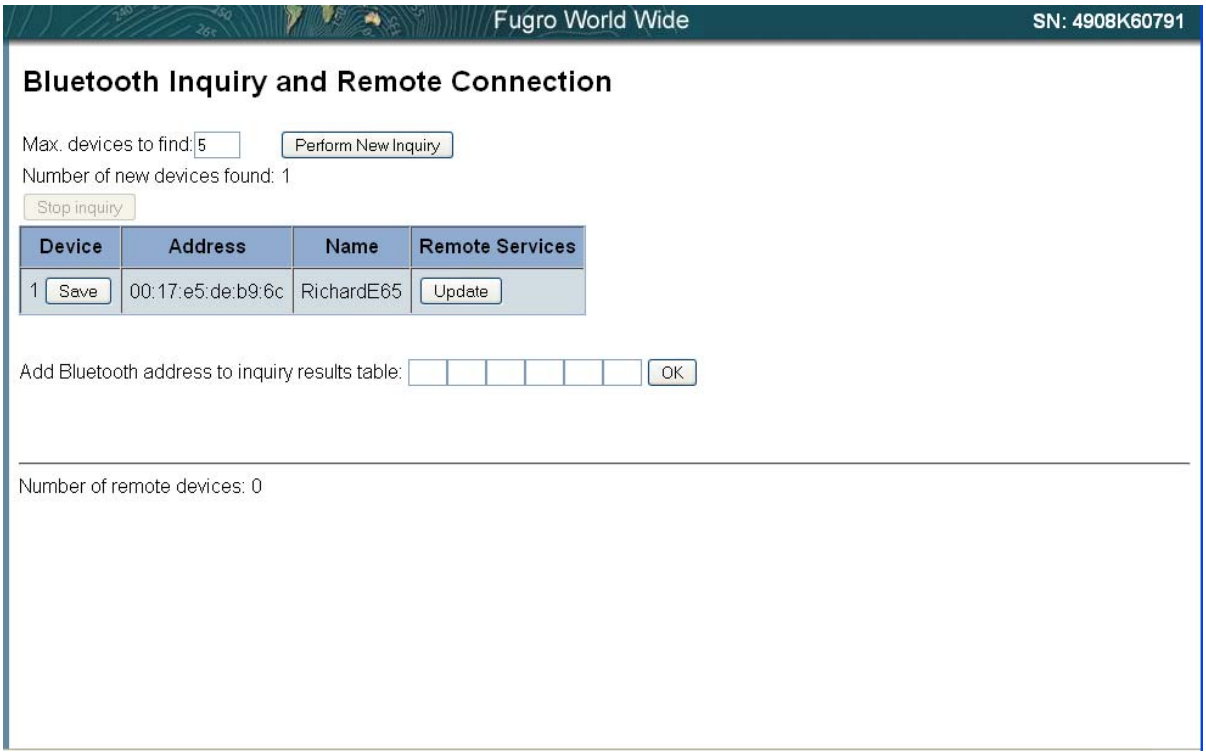


Figure 66: Bluetooth devices within range

Select the device you want to pair and click the 'Update' button under 'Remote Services'. At this stage, the device you are pairing with might ask you to confirm the pairing and it might ask you for the PIN code for the connection (default is 0000). After a few moments, the screen will show a list of possible services the paired Bluetooth device is offering. To start using one of these services, select the desired service, select the Bluetooth port to use and click the 'Connect' button (see Figure 67).

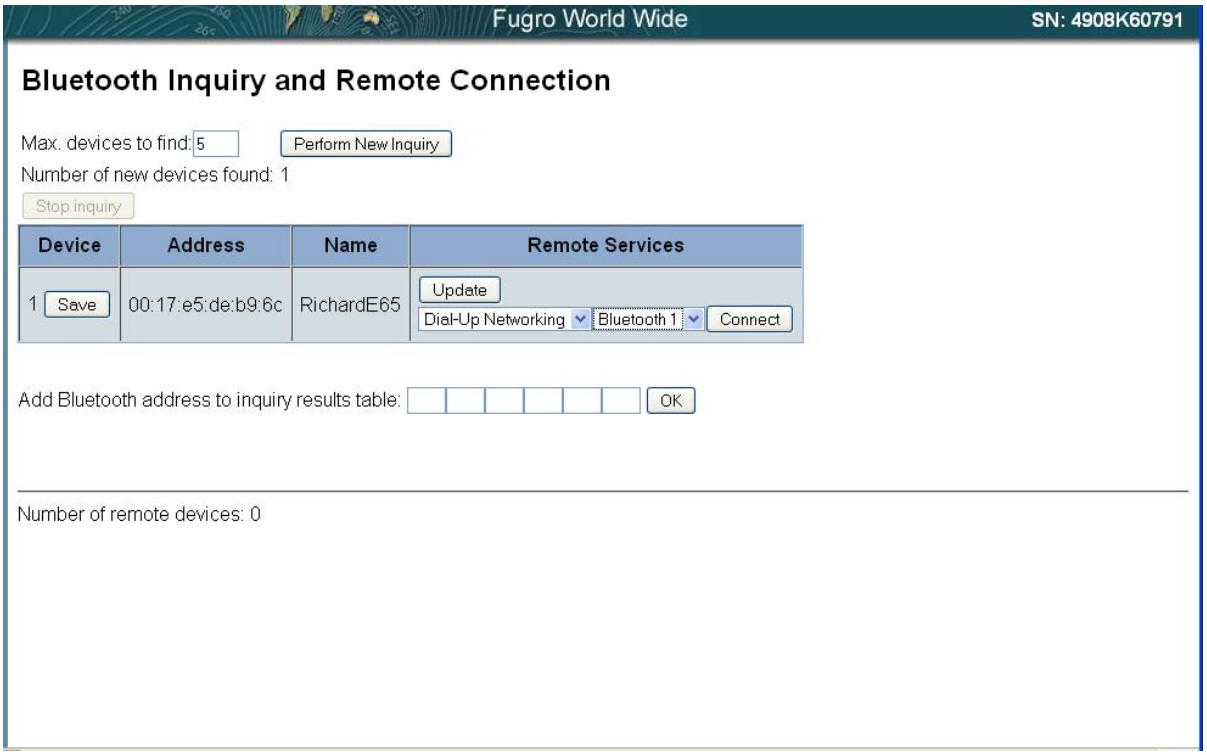


Figure 67: Connecting to a remote service.

After a few moments, the 9200-G2 will show that the remote device is connected and ready to be used (see Figure 68).

NTRIP using a Bluetooth cell phone

When a suitable cell phone has been paired, it can be used as a modem to connect to an NTRIP caster. Using NTRIP as a means to receive SeaSTAR correction data has the advantage that a direct line of sight to one of the SeaSTAR L-band satellites is not required. In urban or suburban environments, in mountainous terrain or in any environment susceptible to L-band interference or blocking, NTRIP can deliver the signals the L-band satellites cannot.

To use a cell phone as a modem, first make sure it has been paired and connected. Next, in the receiver's web interface, select the Network Configuration, PPP menu. Select the Bluetooth port through which the cell phone has been connected and select the Startup script type "External modem script". Enter the Modem Dial String (for GPRS/UMTS connections, this will normally be something like 'ATD*99#', but it may be different for your provider) and click the 'Connect' button (see Figure 69). Depending on your network operator, you might need to fill in the modem init string (which was left blank in Figure 69). For example, to get the GPRS data connection working with UAE provider 'Etisalat', you would need to enter the following modem init string:

```
AT+CGDCONT=1,"IP","etisalat.ae"
```

Omitting the modem init string in this case would result in a failure to establish the mobile internet connection. Whether or not your provider requires a modem init string is beyond the scope of this manual, you might be able to find more information on the internet web site of your mobile telecom provider.

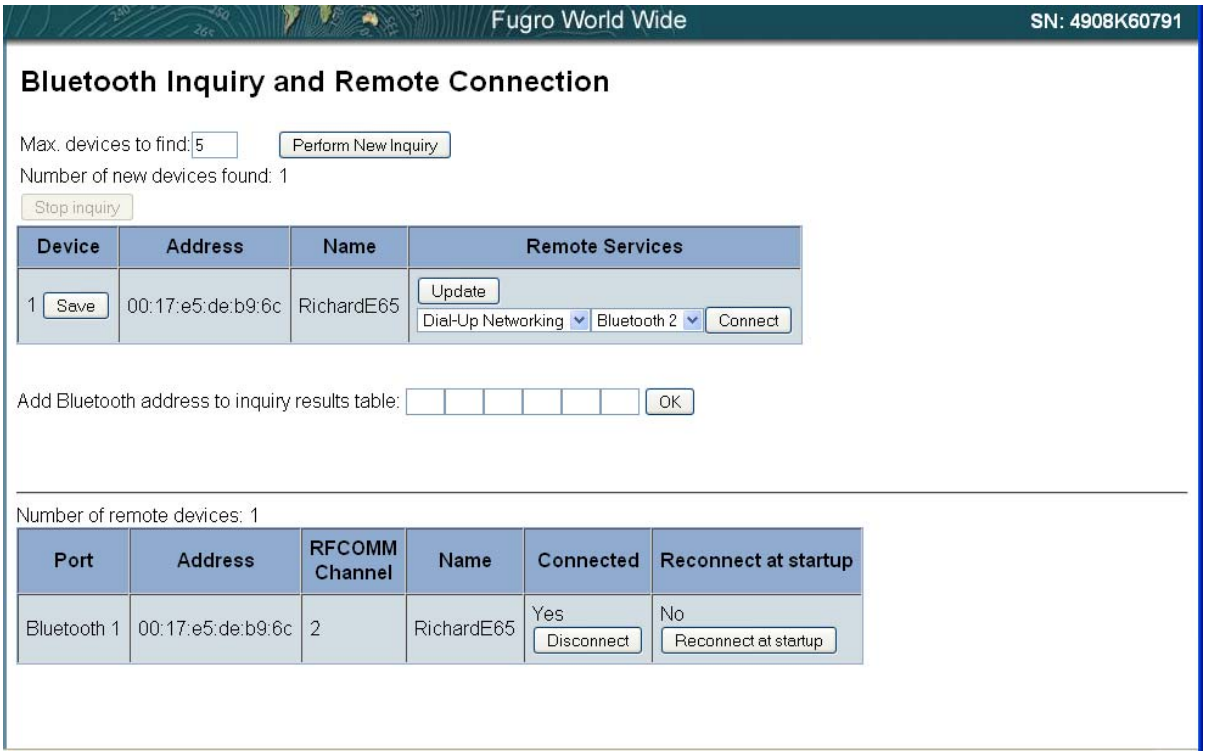


Figure 68: Remote device connected.

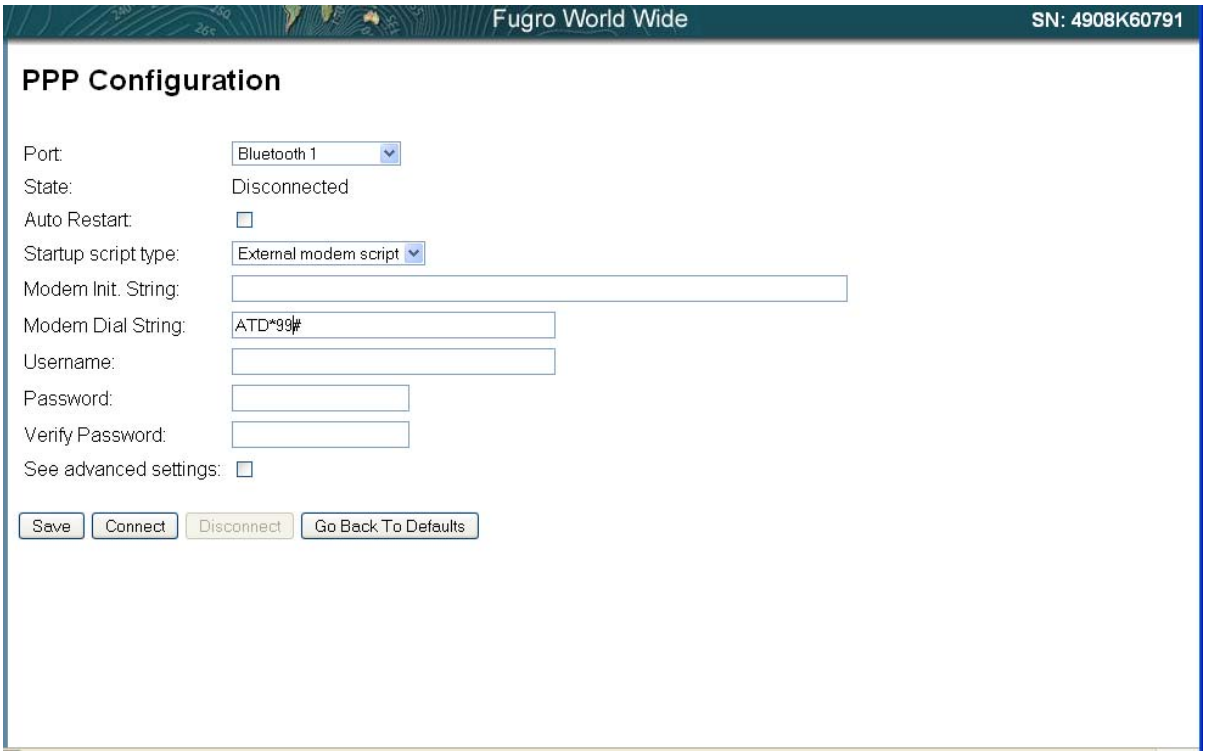


Figure 69: Setting up a PPP connection.

After a few moments, the connection state should change from ‘Disconnected’ to ‘Up and connected’ (see Figure 70), to indicate the internet connection through the cell phone modem has succeeded.

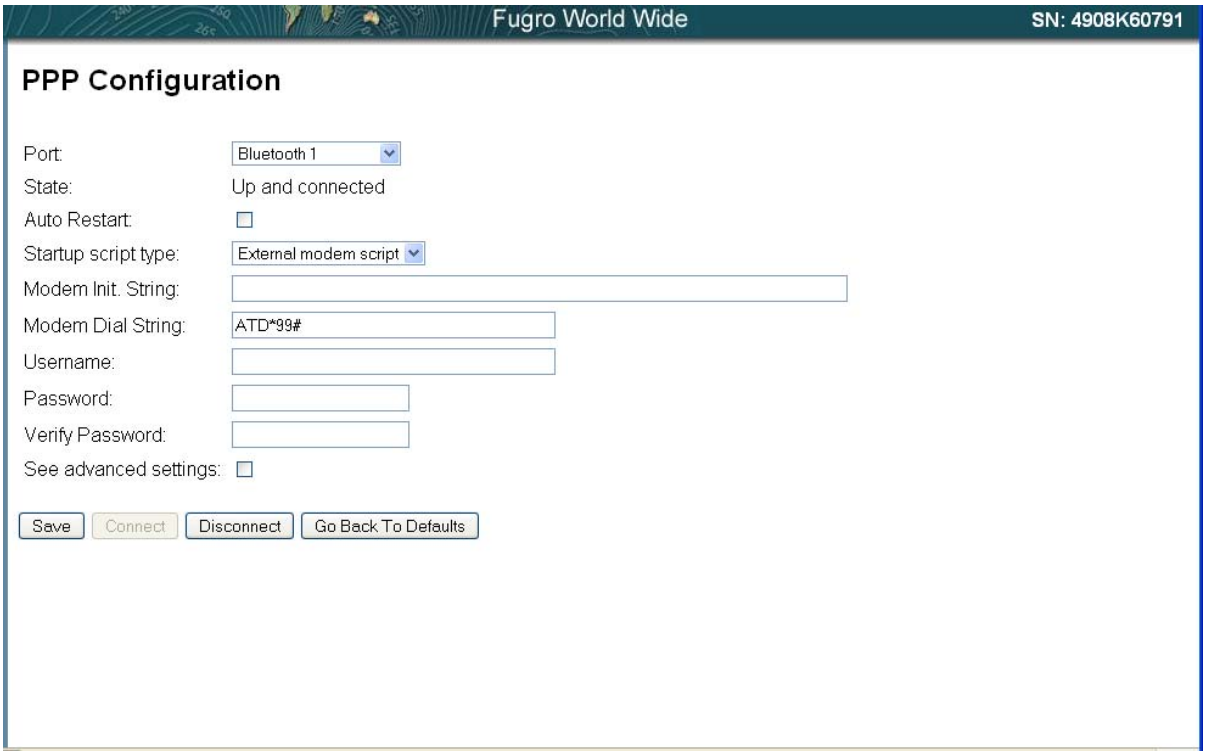


Figure 70: PPP connection up and running.

You can check the PPP connection's external and internal IP address and whether or not the PPP connection is still active by going to the "Network Configuration", "Routing Table" menu (Figure 71).

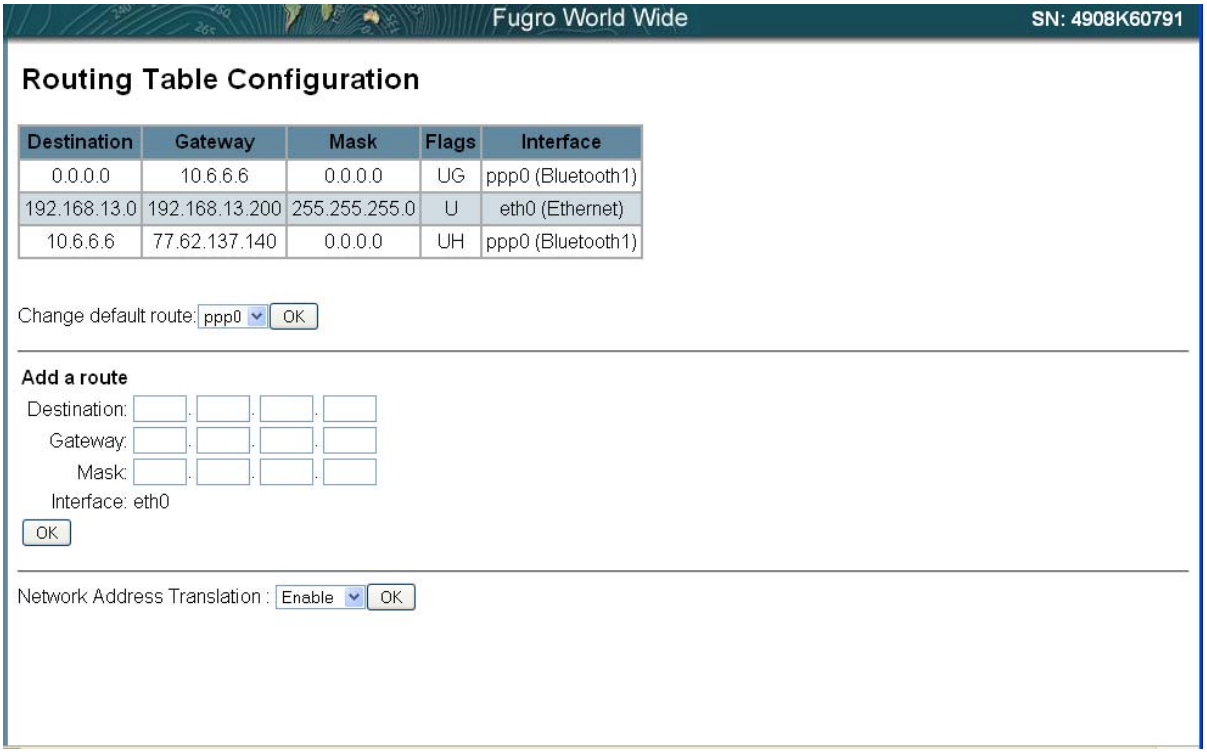


Figure 71: Routing table configuration with active PPP connection.

To set up the connection to the NTRIP server, first select the "I/O Configuration" menu. You will notice the Bluetooth PPP connection being up and connected (see Figure 72).

TCP/IP	5019	-	NMEA-GGA(1Hz) NMEA-GSV(1Hz) NMEA-RMC(1Hz) NMEA-DG(1Hz) NMEA-DP(1Hz)
NTripClient	-	-	-
Serial	Lemo (57.6K-8N1)	-	NMEA-GGA(1Hz) NMEA-GST(1Hz) NMEA-GSV(1Hz) NMEA-GSA(1Hz) NMEA-DG(1Hz)
Serial	Modem 1 (9600-8N1)	-	REPEAT_RTCM_VBS
Serial	Modem 2 (38.4K-8N1)	-	-
Bluetooth	1	PPP-Up and connected	PPP-Up and connected
Bluetooth	2	-	-
Bluetooth	3	-	-
USB	-	-	-
CAN	-	-	-

Figure 72: Bluetooth PPP connection active.

Click the ‘NTripClient’ entry to open the NTRIP client settings menu (Figure 73).

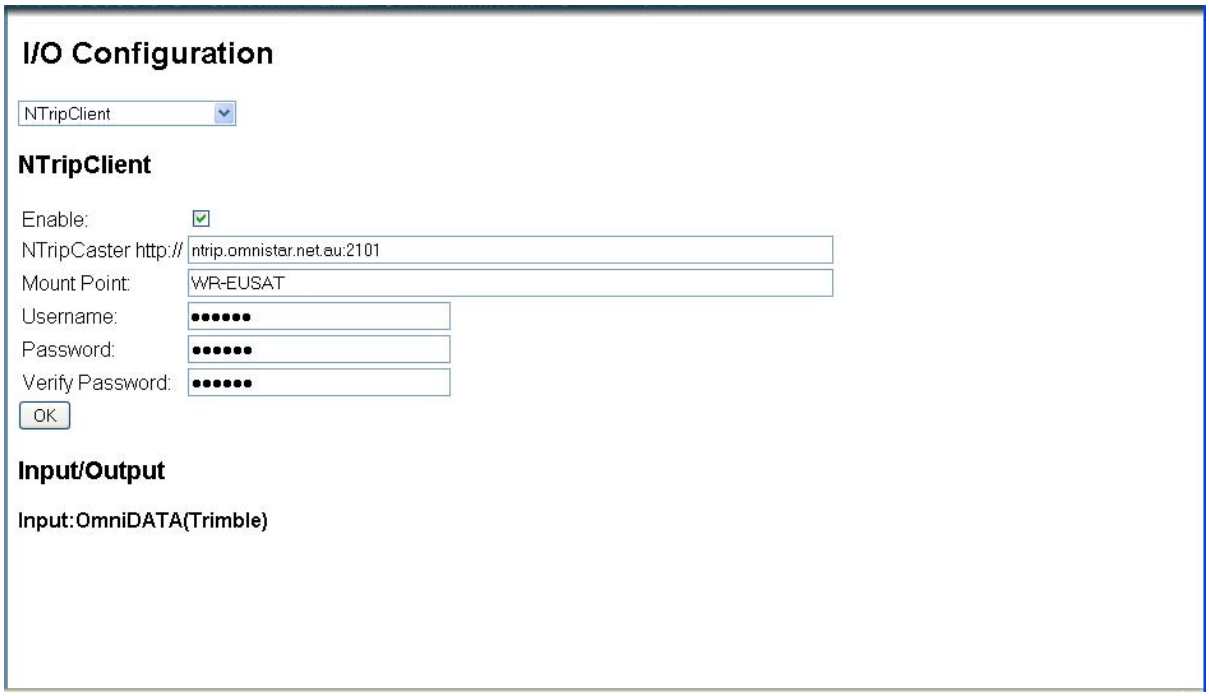


Figure 73: NTRIP client settings.

Enter the address of the NTRIP caster, the mount point and your login credentials. Mind: the 9200-G2 needs a specially wrapped NTRIP data format, which is prefixed in the NTRIP caster with ‘WR-‘. So be sure to select, for example, ‘WR-EUSAT’ instead of ‘EUSAT’, since incoming data from the ‘EUSAT’ mountpoint will not be recognized. Don’t forget to enable the NTRIP client option! After filling in all the required fields, click ‘OK’. The I/O Configuration summary should show the NTripClient being active after a few seconds (green background, input type ‘OmniDATA(Trimble)’ see also Figure 74).

TCP/IP	5019	-	NMEA-GGA(1Hz) NMEA-GSV(1Hz) NMEA-RMC(1Hz) NMEA-DG(1Hz) NMEA-DP(1Hz)
NTripClient	-	OmniDATA(Trimble)	-
Serial	Lemo (38.4K-8N1)	-	NMEA-GGA(1Hz) NMEA-GST(1Hz) NMEA-GSV(1Hz) NMEA-GSA(1Hz) NMEA-DG(1Hz)
Serial	Modem 1 (9600-8N1)	-	REPEAT_RTCM_VBS
Serial	Modem 2 (38.4K-8N1)	-	-
Bluetooth	1	PPP-PPPUp	PPP-PPPUp
Bluetooth	2	-	-
Bluetooth	3	-	-
USB	-	-	-
CAN	CAN1	-	-

Figure 74: NTRIP client active.

When the receiver is using NTRIP data (instead of L-band data), the status information screen (see Figure 43) will show “Signal Source: External” instead of “Signal Source: Demodulator” (see Figure 75)

L-Band Beam Status:

Signal Source:	External
Tracking Mode:	Outputing HP+G2
Satellite Link ID:	
Satellite Link Name:	EUSAT
Frequency [MHz]:	1537.4400
Bit Rate [Hz]:	1200
Eb/No [dB]:	
C/No [dBHz]:	

Figure 75: L-band beam status when using NTRIP connections.

PPP Network connection over Bluetooth

It is possible to use a Bluetooth connection between the 9200-G2 receiver and a Bluetooth-capable computer as a network link, enabling the use of the receiver’s web interface even though a physical Ethernet connection is not available. Initial setup, however, still requires an Ethernet connection.
In order to setup the Bluetooth network connection, the computer must have a Bluetooth COM port installed. Please refer to your computer’s manual(s) for the Bluetooth installation.
When a Bluetooth COM port is available, open the Network Connections from the Control Panel and click ‘Create a new connection’.

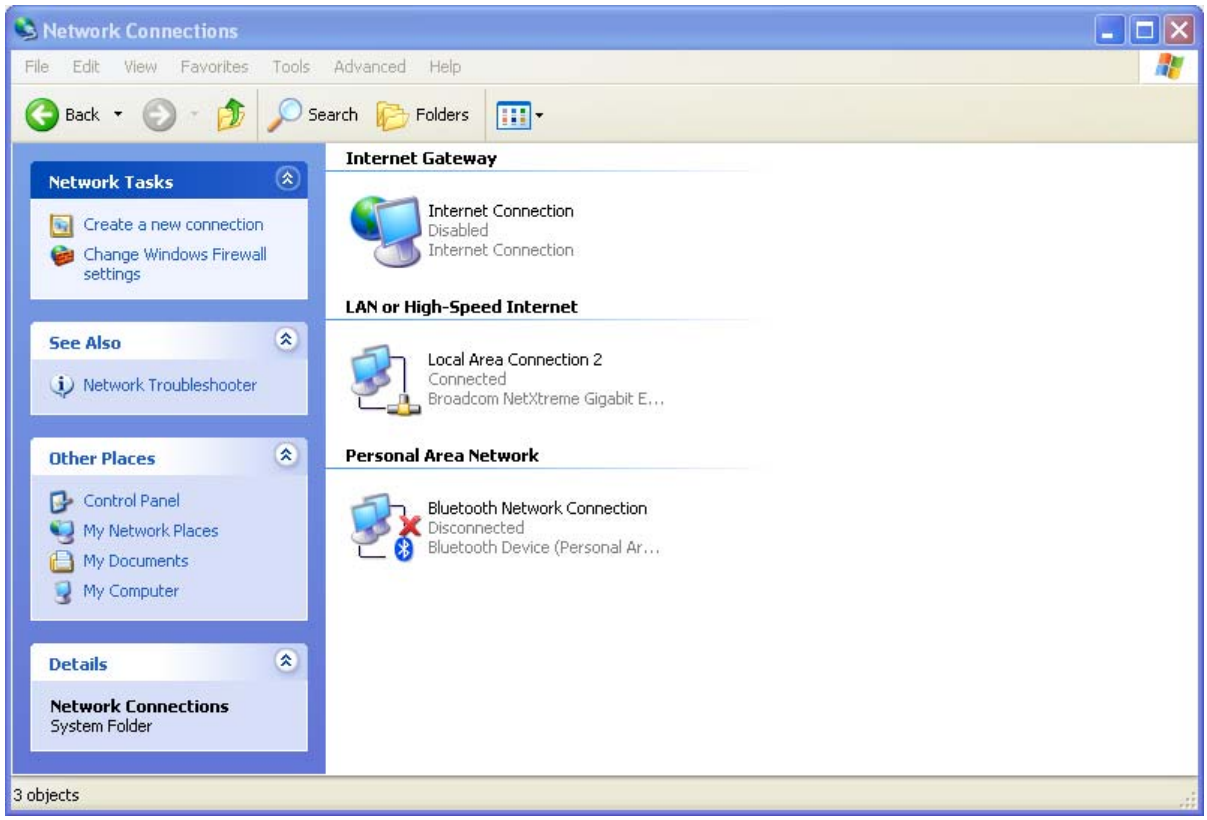


Figure 76: Network Connections

The New Connection Wizard will open. Click ‘Next’ to continue setting up the connection.

Figure 77: New Connection Wizard

Select ‘Setup an advanced connection’ and click ‘Next’

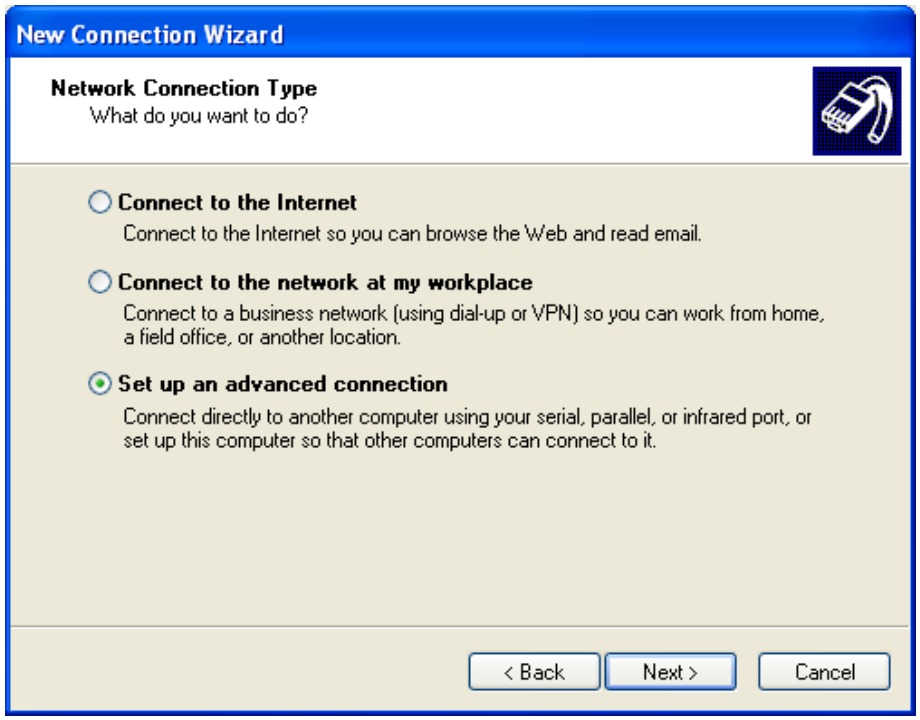


Figure 78: Advanced connection setup

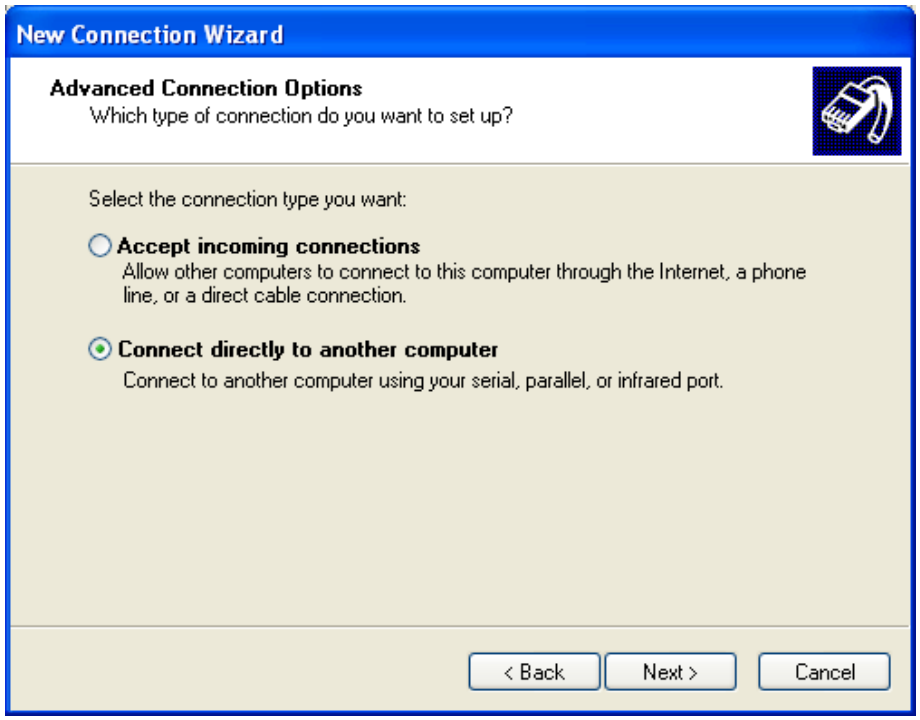


Figure 79: Direct computer connection

Select ‘Connect directly to another computer’ and click ‘Next’.

Figure 80: Connection mode

The computer will be the guest system, so select the ‘Guest’ role and click ‘Next’.

Enter a meaningful name for the new connection and click ‘Next’.

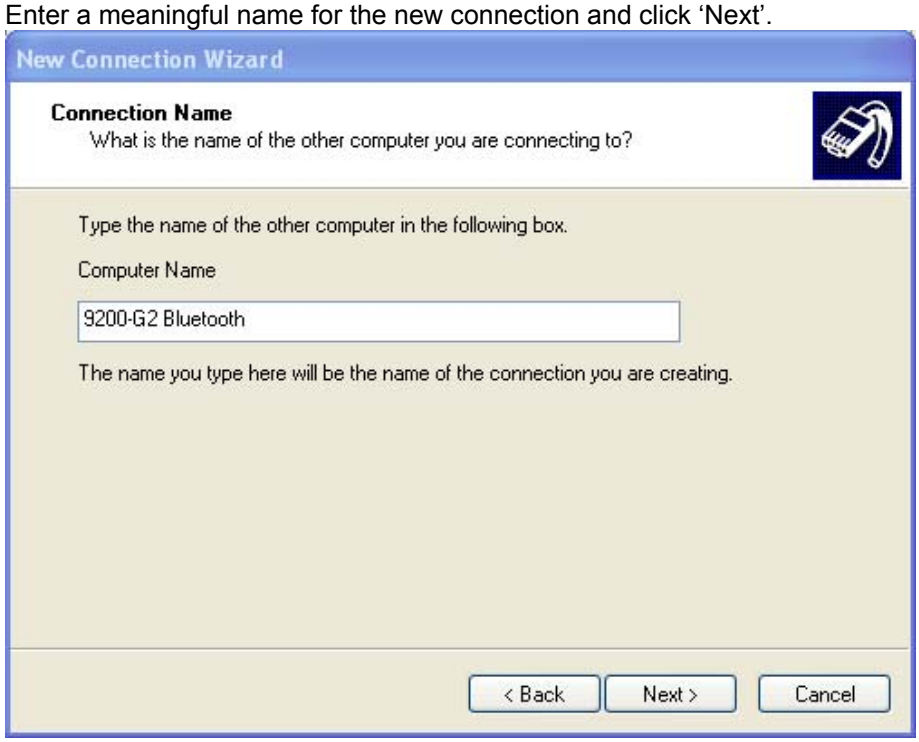


Figure 81: Connection name

Now select the Bluetooth port that will be used for the communication between the computer and the 9200-G2 receiver and click ‘Next’.

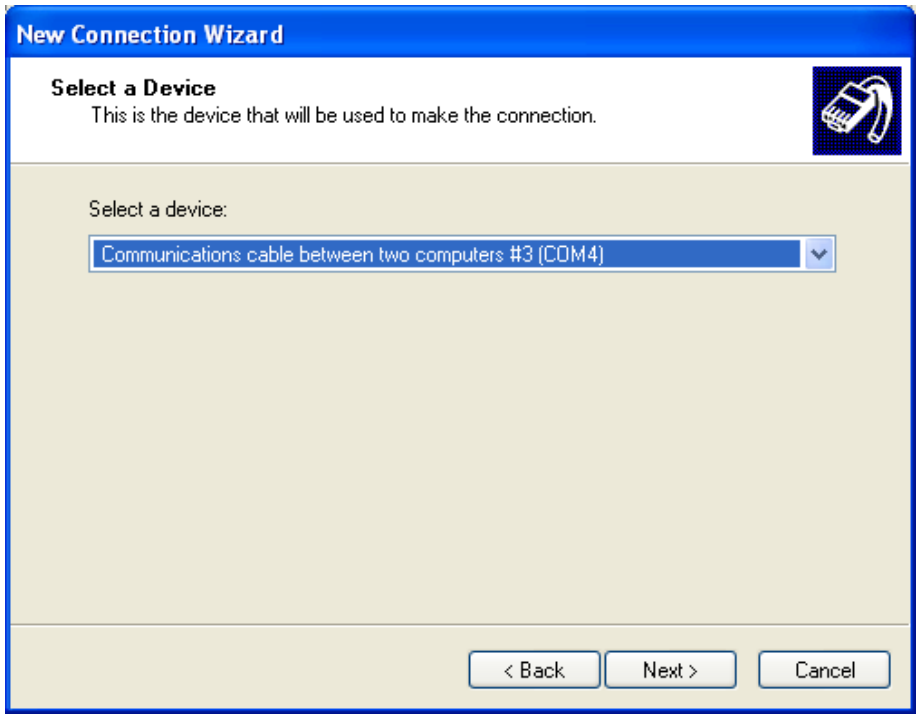


Figure 82: Selecting a communication port

The connection may be used by anyone using the computer, so select ‘Anyone’s use’ and click ‘Next’. The setup of the new connection is now completed and the properties of the connection can be adjusted.

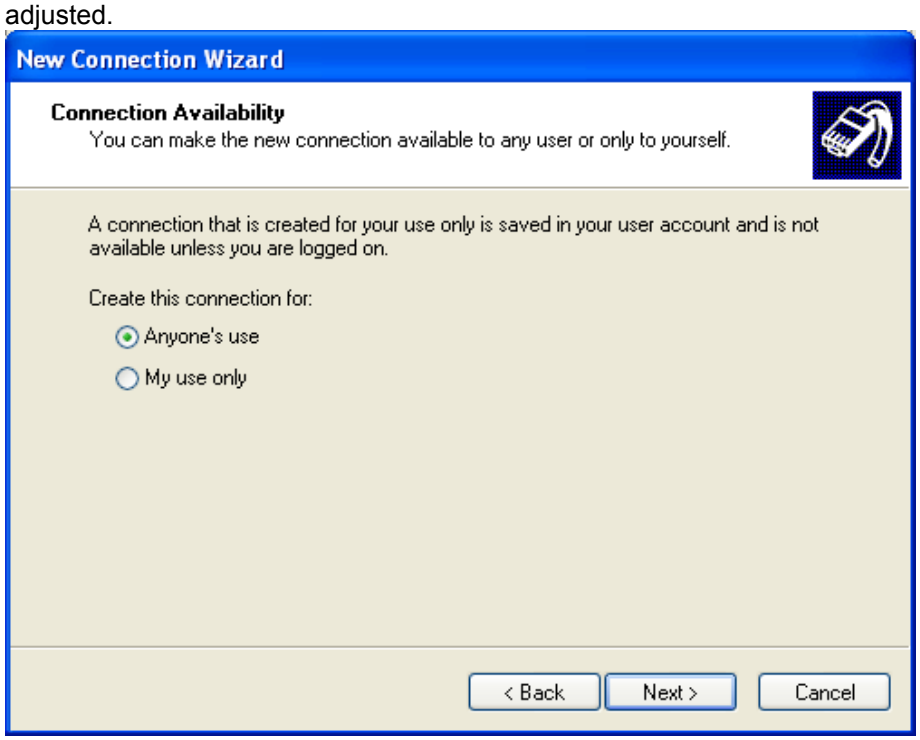


Figure 83: Connection availability

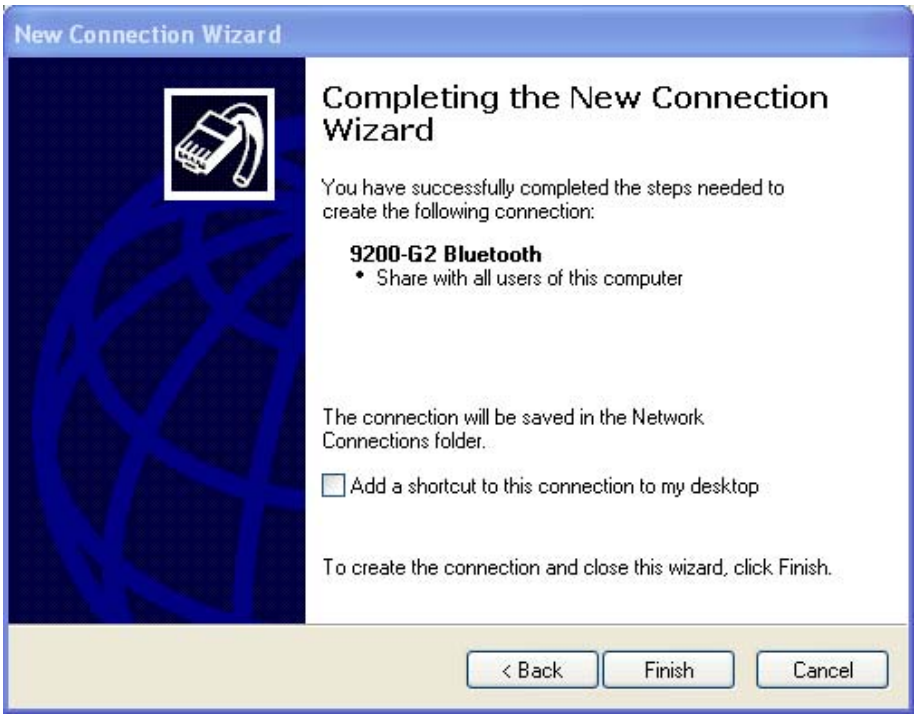


Figure 84: Connection completed

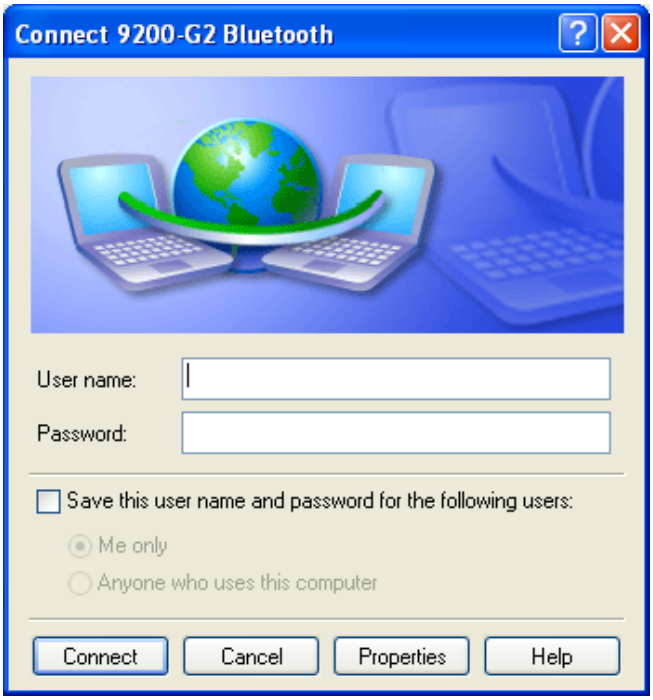


Figure 85: Connecting to the receiver

A user name and password are not needed for the connection with the receiver, so leave those fields blank. Click the 'Properties' button to adjust the communication properties. The properties window will open on the 'General' tab (Figure 86). Click 'Configure' to adjust the communication speed (19200 by default). Since the speed entered is the maximum speed, choose the highest available speed from the drop-down box (probably 921600, see Figure 87). Click 'OK' to store the changes and select the 'Networking' tab (Figure 88). Make sure to disable 'File and Printer Sharing for Microsoft Networks' and click 'OK'.

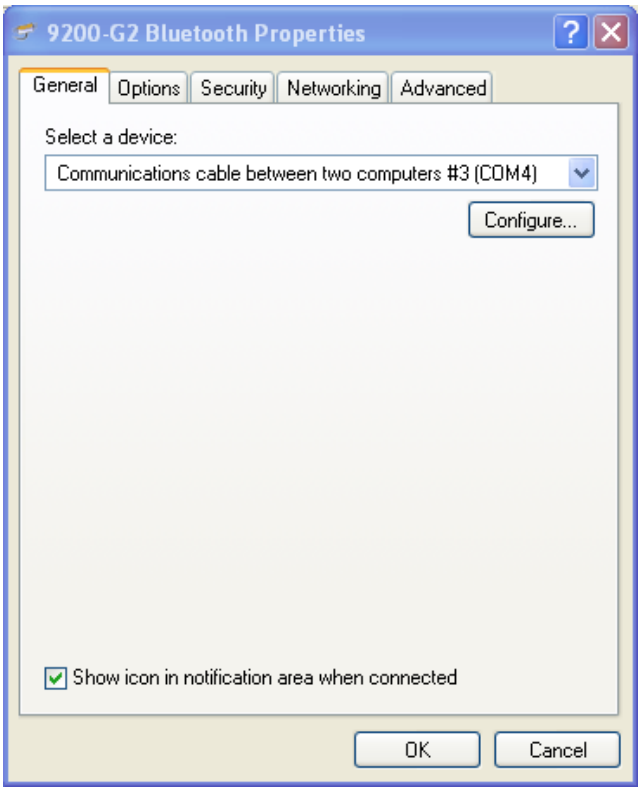


Figure 86: Connection properties

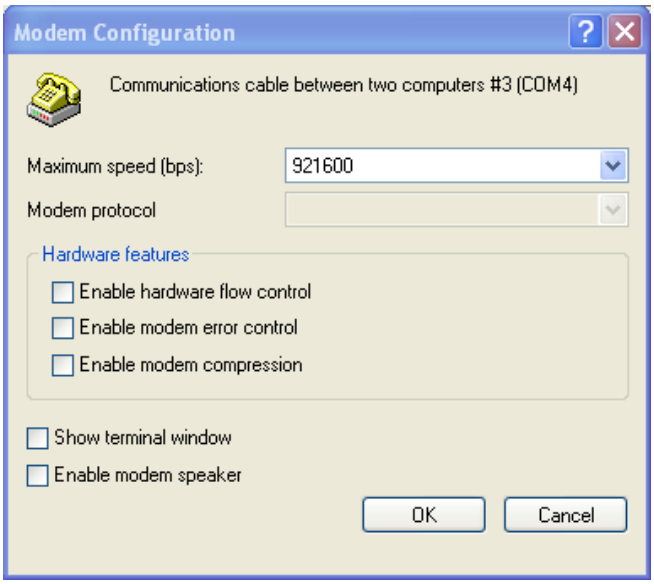


Figure 87: Setting connection speed

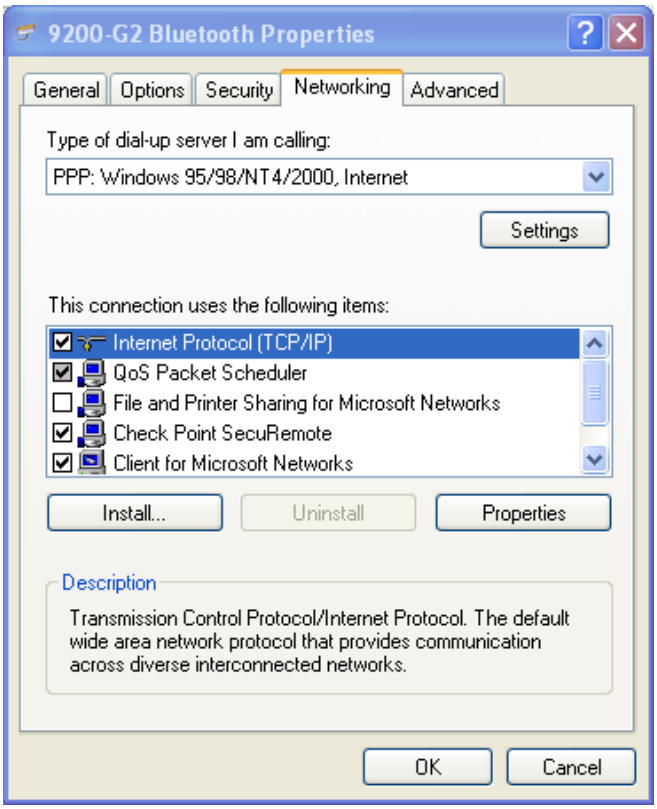


Figure 88: Selecting communication protocols

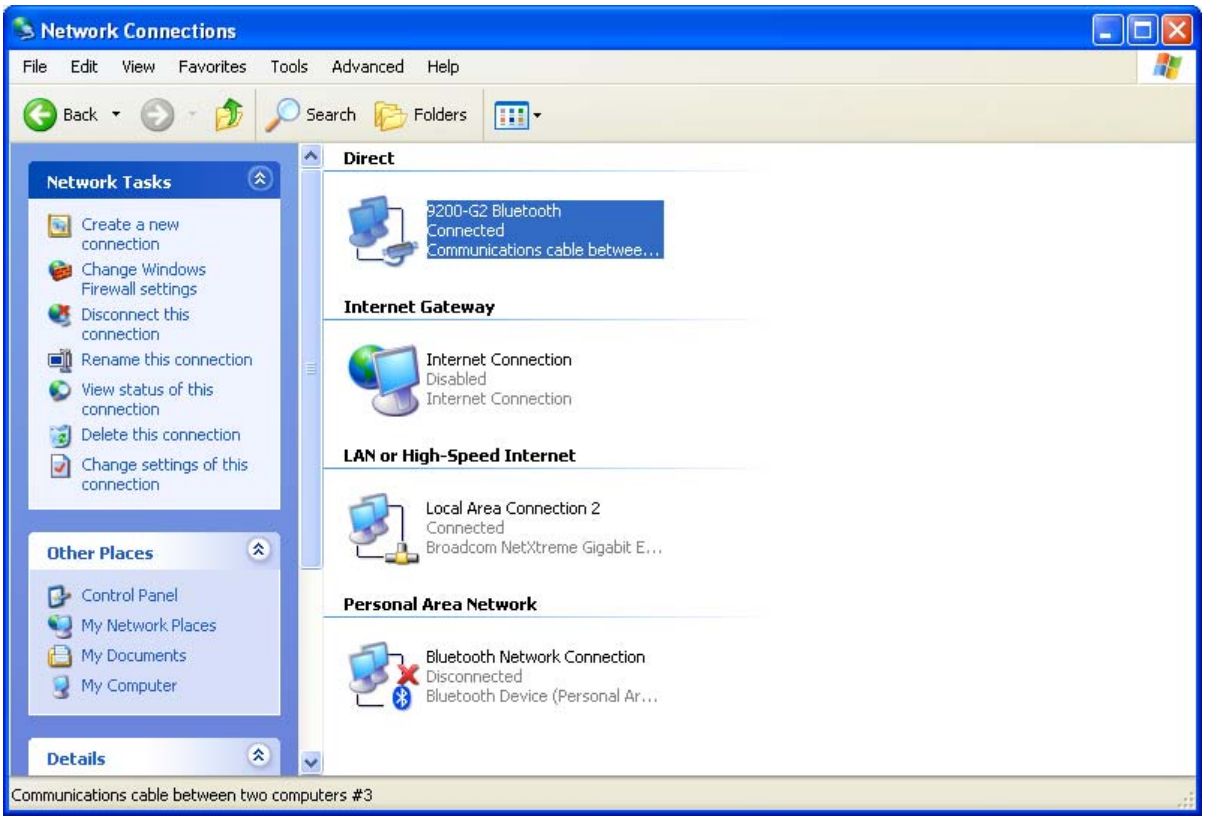


Figure 89: Connection succeeded.

After a short time, a new network connection will show up in the Network Connections screen. If everything went well, the status will be ‘Connected’. Check the front display of the receiver and press the ▲ button once. This will show the receiver’s IP address. Press the ▲ button once more and the

receiver's PPP IP address will be shown (see Figure 90). Open a web browser and enter the PPP IP address in the address bar. The receiver's web interface should now show up.

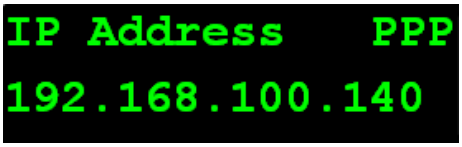


Figure 90: PPP IP address of the receiver

Appendix E

Acronyms used in this manual

1PPS	**One Pulse Per Second**
2D	**Two Dimensional**
3D	**Three Dimensional**
ASCII	**American Standard Code for Information Interchange**
BER	**Bit Error Rate**
BPS	**Bits per Second**
CEMF	**Counter Electro-magnetic Force**
dB	**Decibel**
DGLONASS	**Differential Global Navigation Satellite System**
DGNSS	**Differential Global Navigation Satellite System**
DGPS	**Differential Global Positioning System**
DOP	**Dilution of Precision**
EGNOS	**European Geostationary Navigation Overlay Service**
GLONASS	**(ГЛОНАСС) GLObal NAvigation Satellite System**
GNSS	**Global Navigation Satellite System**
GPS	**Global Positioning System**
GSOF	**General Serial Output Format**
HP	**High Performance**
LCD	**Liquid Crystal Display**
LNA	**Low Noise Amplifier**
NCC	**Network Control Centre**
NMEA	**National Marine Electronics Association (Standard for interfacing marine electronic devices)**
MSAS	**MTSAT Satellite based Augmentation System (Japan)**
RF	**Radio Frequency**
RTCM	**Radio Technical Commission Maritime**
VBS	**Virtual Base Station**
VFD	**Vacuum Fluorescent Display**
WAAS	**Wide Area Augmentation System (USA)**
XP	**Extended Performance**

Appendix F

Updating the 9200-G2 firmware

Although your receiver is shipped with the latest version of the receiver firmware pre-installed, new firmware versions are being released on a regular basis. Please contact SeaSTAR support for information about your firmware version (seastarservice@fugro.no).

The firmware inside the 9200-G2 receiver can be upgraded through the receiver web interface or through one of the receiver's RS-232 communication ports using the 'WinFlash' program. A firmware upgrade using the web interface typically takes about 6 minutes. A firmware upgrade using one of the RS-232 communication ports will take approximately 25 minutes. For the upgrade procedure using the web interface, please refer to the Firmware menu (page 52).

In case an Ethernet connection with the receiver is normally not available but you would still like to upgrade the receiver using the web interface, you may setup a PPP network connection using Bluetooth. Please refer to Appendix D on page 93 for the details.

WinFlash

After downloading, installing and starting the WinFlash program, it will show the Device Configuration screen. The 9200-G2 receiver is compatible with the SPSx5x series of receivers, so choose this option to be able to communicate with your 9200-G2. Connect an RS-232 cable (either the cable connected to the receiver's Lemo-port or a null modem cable connected to the RS-232 connector of the provided multiport connector break-out box) to an available RS-232 port of your desktop or laptop computer and select this port in the 'PC serial port' box (see Figure 91 below). Click 'Next>' to proceed.

Figure 91: WinFlash device configuration screen

The operation selection screen will be presented, in which a number of operations can be selected (see Figure 92). Select 'Load GPS software' to update the receiver firmware and click 'Next>'.

Figure 92: WinFlash Operation Selection screen

Figure 93: WinFlash GPS Software Selection screen

In the GPS Software Selection screen (Figure 93), select the appropriate firmware version and click ‘Next>’. This will open the Settings Review screen (Figure 94), in which all the selected settings are presented. When all settings are correct, click ‘Finish’ to start the firmware update. Note that the

update itself will take a considerable amount of time, so please be patient and do not disconnect the receiver.

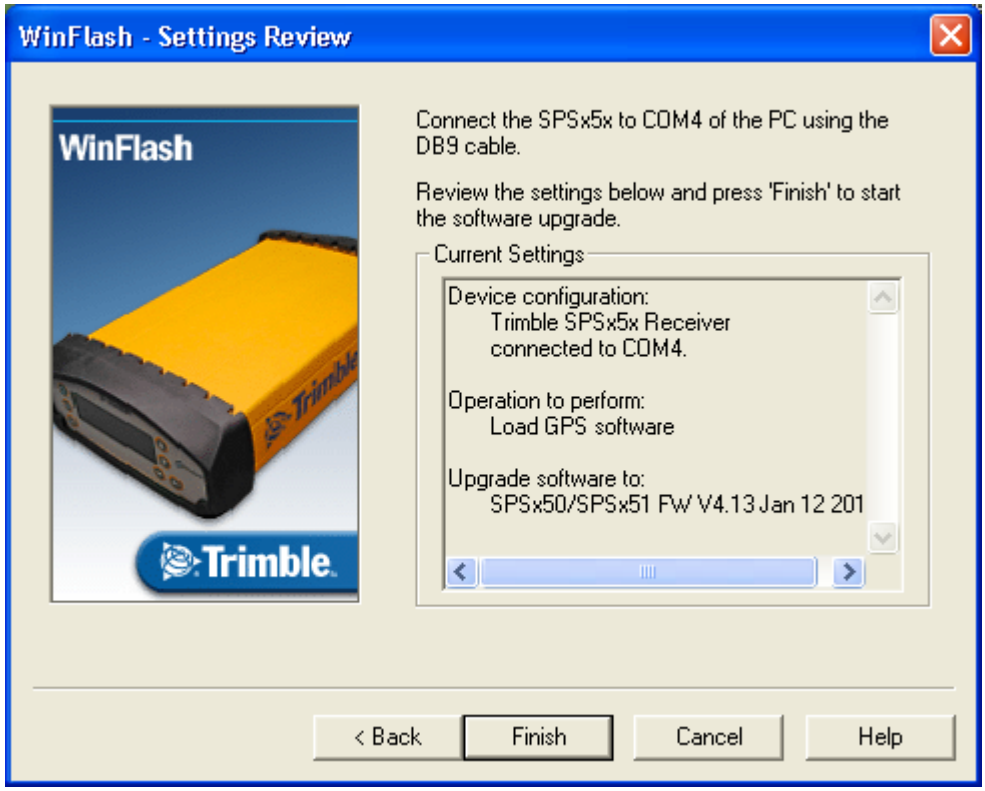


Figure 94: WinFlash Settings Review

The update itself consists of a number of steps: configuring the software update and establishing a connection with the 9200-G2 (Figure 95), uploading the new firmware to the receiver's fail safe memory (Figure 96), copying the new firmware from failsafe memory to main memory (Figure 97) and erasing the data logging area and cleaning up the fail safe memory after the firmware has been copied to main memory (Figure 98). After all these steps have finished, the WinFlash program will notify you of the successful update of the firmware (Figure 99). When you see this screen, you may disconnect and/or switch off the 9200-G2 receiver.

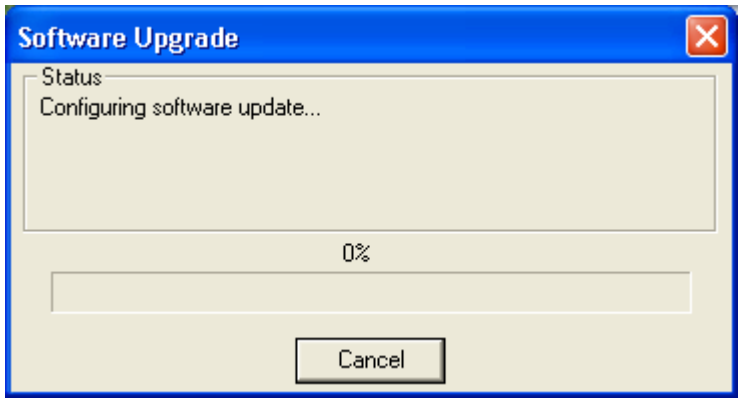


Figure 95: Software upgrade starting

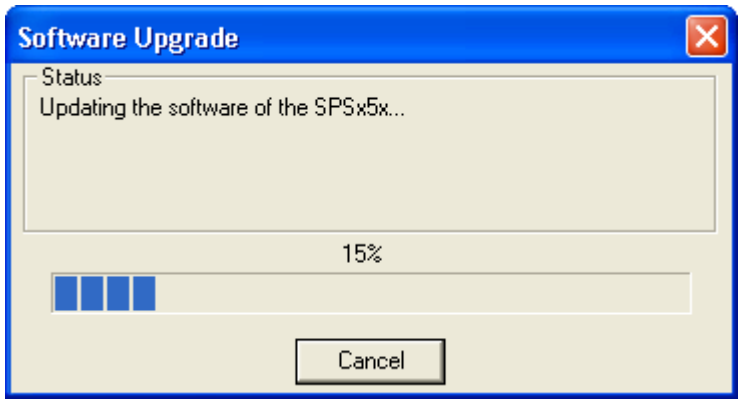


Figure 96: Updating software

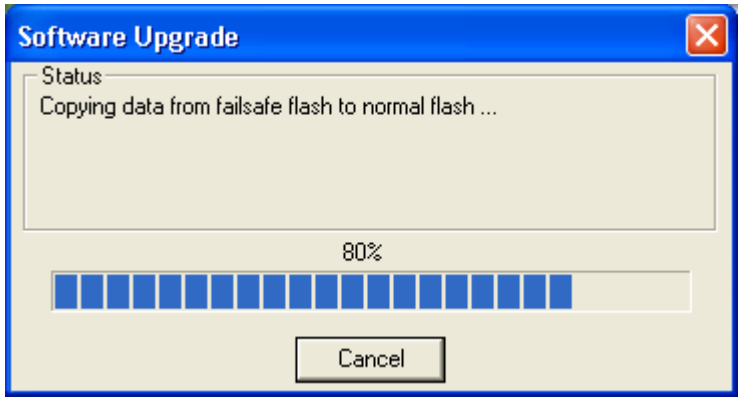


Figure 97: Firmware copy to normal flash memory

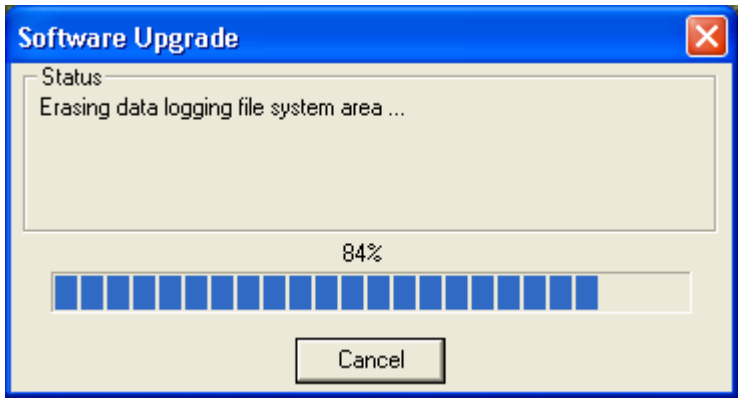


Figure 98: Erasing data logging area

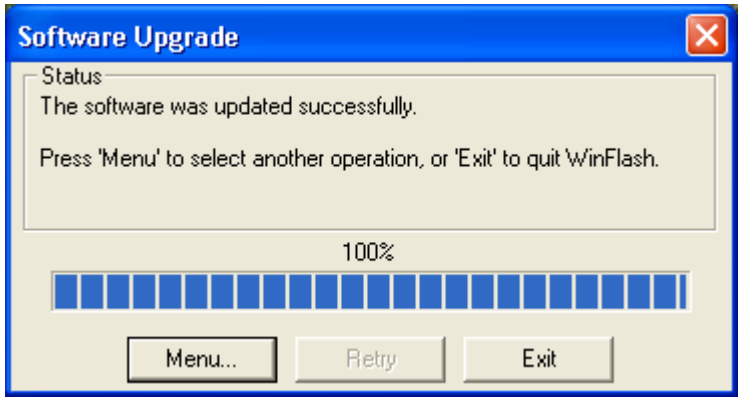


Figure 99: Software upgrade successful

Appendix G

SeaSTAR reference stations

For its satellite based DGNSS service, SeaSTAR uses correction data from a number of reference stations distributed all over the globe. The most recent map can be found on the internet: See http://www.skyfix.com.

Appendix H

Receiver Service Procedure

If an SeaSTAR receiver unit fails to perform, contact the SeaSTAR office within the region, after following the procedural checks. We wish to hear about frequently experienced problems and your assistance will help by copying the form on the next page, filling in the details requested and faxing or mailing the form to the SeaSTAR office for on-forwarding to Product Marketing.

The most common problems are interfacing, and usually occur at installation time. If you have an interfacing connection not covered in this manual we would like to assist you and produce another technical bulletin that may assist other users in the future.

If a problem appears that you think may be caused by a system performance problem, contact the SeaSTAR office in your region for any system aberrations that may have been experienced.

We are sensitive to our customers' needs and we want to assure specified system performance at all times. There could, however, be situations where conditions are below par, such as fringe area operations, radio communication disturbance etc., and, as SeaSTAR monitors the system performance continuously, these conditions would be noted.

Appendix I

SeaSTAR Receiver Problem Report Form

Please copy this form and report problem with as much detail as possible.

Problem with: Signal Y/N Manual Y/N SeaSTAR Y/N Receiver Y/N	Date:
Description of problem:	
Person Reporting:	Contact Phone #:
Customer Name:	Customer Address:
Customer Phone #:	
Date purchased: / /	Dealer:
GNSS Receiver used: SeaSTAR 9200-G2	Serial #:
Area of operations:	
Symptoms from display (if any):	

User Notes